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BULLETIN No. 138

COASTAL SAN MATEO COUNTY INVESTIGATION

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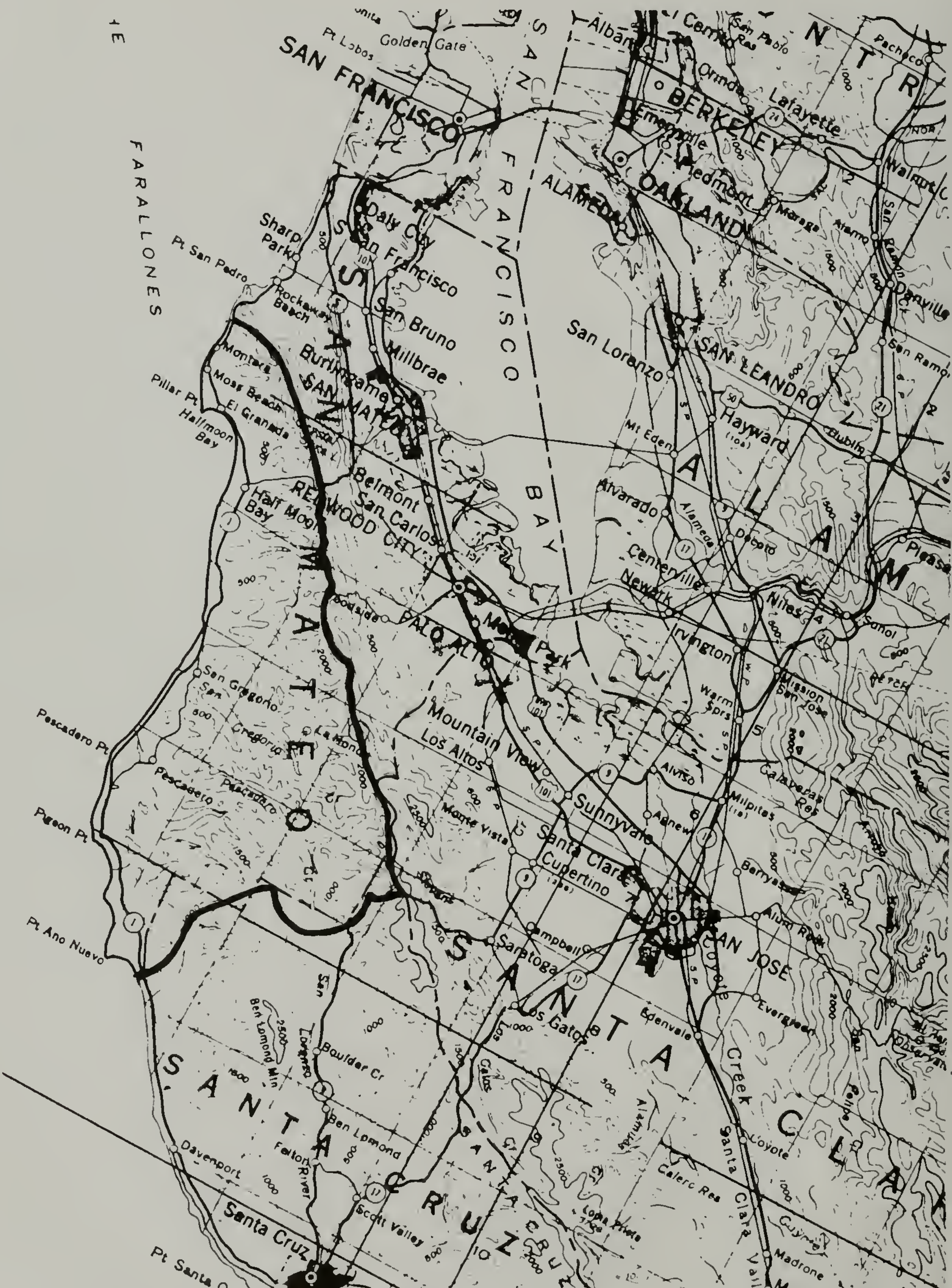
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State of California
THE RESOURCES AGENCY
Department of Water Resources

BULLETIN No. 138

COASTAL SAN MATEO COUNTY INVESTIGATION

MARCH 1966

HUGO FISHER *Administrator* The Resources Agency	EDMUND G. BROWN *Governor* State of California	WILLIAM E. WARNE *Director* Department of Water Resources

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OF CALIFORNIA—RESOURCES AGENCY WILLIAM E. WARNE, *Director*

ARTMENT OF WATER RESOURCES
OX 388
ENTO

December 13, 1965

Honorable Edmund G. Brown, Governor
and Members of the Legislature
of the State of California

Gentlemen:

I am pleased to transmit herewith the final edition of Bulletin No. 138 "Coastal San Mateo County Investigation". The objective of this investigation is to formulate a comprehensive development plan which will serve as a guide to the solution of the water resources associated problems of the area.

The results of our studies indicate that improved highway transportation facilities to be constructed during the coming decade will allow the coastal area of San Mateo County to participate in the rapid growth of the San Francisco Bay Area. This growth will be accompanied by increasing demands for water supplies and fresh water recreation opportunities. The studies also revealed that the water requirements of this area could be met by development of local streams. A number of damsites were evaluated and six staged development plans were formulated and tested for economic justification. An economically justified staged development plan which offers the opportunity to maximize the net benefits accruing to the coastal area is recommended for feasibility study by the local people.

A public hearing was held to receive comments from all public and private agencies, and local interests. All the comments received were considered in preparing the final report.

Sincerely yours,

William E. Warne
Director

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

EDMUND G. BROWN, Governor
HUGO FISHER, Administrator, The Resources Agency
WILLIAM E. WARNE, Director, Department of Water Resources

ALFRED R. GOLZE', Chief Engineer
JOHN R. TEERINK, Assistant Chief Engineer

------------0------------

SAN FRANCISCO BAY DISTRICT

Charles A. McCullough	District Director
Jerry D. Vayder	Chief, Planning and Investigations Section

This investigation was conducted
under the supervision of

Donald J. Finlayson	Senior Engineer, Water Resources

by

John L. Hyde	Water Resources Engineering Associate
Michael P. Saunders	Assistant Civil Engineer

Specialized Studies

Economics	Sidney M. Fellows, Associate Economist
Fish and Game	Emil J. Smith, Jr., Fishery Biologist III
Geology	Robert E. Thronson, Assoc. Engr. Geologist
Land and Water Use	Richard J. Wagner, Senior L&WU Analyst
Recreation Planning	Stanley J. Thompson, Rec. Planner III
Water Quality	James C. Mosley, Assoc. Engr., W. R.

The first year of this three year investigation was conducted by
Frank S. Davenport Associate Engineer, Water Resources

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----------0----------

WILLIAM M. CARAH
Executive Secretary

ORVILLE L. ABBOTT
Engineer

ACKNOWLEDGMENT

Valuable assistance and data used in this investigation were contributed by the U. S. Army Corps of Engineers, U. S. Geologic Survey, California Division of Soil Conservation, San Mateo County Flood Control District, San Mateo County Farm Advisors Office, San Mateo County Soil Conservation District, Coastside County Water District, and by private companies and individuals.

SUMMARY

Continued population growth and increasing demands for developable land in the San Francisco Bay Area will exert great urbanizing pressures on the coastal area of San Mateo County, south of Montara Mountain. This area is the last large, close-in district on the peninsula suitable for development. Urban growth will bring increasing demands for municipal and industrial water supplies. Maintenance of the existing agricultural economy of the area also requires the provision of additional water. Other water resources related problems such as the demand for fresh water recreation facilities, flood control, and anadromous fishery preservation can also be expected to accompany the growth of the coastal area.

In order to analyze the extent of the anticipated water resources related problems, and to evaluate possible solutions to these problems, the Department requested funds for an investigation from the 1962 Budgetary Session of the State Legislature. This bulletin reports the findings of the investigation.

Projections of population for the coastal area indicate an increase from 7,635 persons in 1960 to 118,000 in 2020 and to about 238,000 under conditions of maximum development. This great increase will result from the development of the coastal area as a "bedroom area". This growth will be made possible by the completion of modern standard highway transportation facilities which will allow the working force of the coastal area to commute to other parts of the San Francisco Bay Area.

The demand for the specialty crops grown in the coastal area is expected to increase. Although urbanization will completely displace agriculture under conditions of ultimate development, there is sufficient land available to maintain the agricultural economy for several decades after the year 2020.

The annual water requirements of the projected economy of the coastal area are estimated to be 26,300 acre-feet in 2020 and in excess of 45,000 acre-feet at maximum development. A portion of this demand can be met from existing developments. The annual supplemental requirements are estimated to be 19,600 acre-feet in 2020 and over 34,000 acre-feet at maximum development.

The runoff of the streams of the coastal area was analyzed to determine if the supplemental water requirements could be supplied by local development. It was found that there were adequate supplies of good quality water for all beneficial uses.

Having determined that adequate local runoff was available, physical works to conserve this runoff were evaluated. A total of 43 dam and reservoir sites were studied. Twelve of these sites were given detailed study and were considered, together with appropriate diversion and conveyance facilities, to be possible units of staged development plans to meet the supplemental water requirements of the area.

Six alternative staged development plans were formulated. The units of each plan were staged to the year 2020 and the additional units required to meet the estimated maximum supplemental requirements were defined. Each plan was tested for economi justification for a 50-year period of analysis from 1970 to 2020. The present worth of the costs of the units needed during period of analysis and the present worth of the benefits accruing during the period were determined. Benefits and costs of each of the water conservation plans were evaluated to determine economic justification. Projects which appeared to be economically justified for water conservation were further evaluated to determine if other project purposes were economically justified.

As a result of this analysis and considering the aspects of multiple resource management, an economically justified plan based on the offstream storage of Pescadero Creek and Butano Creek waters in Bean Hollow Reservoir was recommended for feasibility study by an area-wide local agency which could implement water resource development in the coastal area.

PUBLIC HEARING
on
Preliminary Edition
of
Bulletin No. 138
"Coastal San Mateo County Investigation

In accordance with Section 232 of the Water Code, the Department of Water Resources held a public hearing on April 21, 1965, in Half Moon Bay, California, to receive comments on the preliminary edition of Bulletin No. 138 "Coastal San Mateo County Investigation."

As a result of information received at the public hearing, certain aspects of the bulletin were reevaluated. Population projections were reconsidered because of the possibility of an increased growth rate in the northern area of the investigation. More accurate mapping of the Worley Reservoir area indicated that the design capacity of the reservoir could be impounded by a lower dam. The effect of this change was evaluated with regard to the cost of the dam, the present worth of the staged development plans which include Worley Reservoir as a feature, and the recreational aspects of the area. These revisions are included inthe final edition of the bulletin.

Verbal comments were made at the hearing by:

Mr. V. K. Sanders, Manager
San Mateo County Flood Control District

Mr. G. S. Henning
Kennedy Engineers for
Coastside County Water District

Mr. G. E. Dunn
Half Moon Bay, California

Written comments were received from:

California Department of Public Works
Division of Highways

California Department of Conservation
Division of Forestry

Mrs. J. Fassler, Supervisor
San Mateo County, California

CHAPTER I - INTRODUCTION

The coastal area of San Mateo County, south of Montara Mountain, is the last large, close-in district which has not participated in the rapid growth of the San Francisco Bay Area.* Continued population growth and increasing demands for developable land will exert great urbanizing pressures on the coastal area. Increasing demands for municipal and industrial water supplies will accompany this urban growth. Satisfaction of these demands will require either the development of local water resources or the importation of supplies from the Sacramento-San Joaquin Delta or from the North Coast.

In addition to these approaching problems of urban water supply, other water resources related problems either exist or will soon occur in the coastal area. A deficiency in the firm agricultural water supply already exists. Fresh water recreation facilities are limited and the anadromous fishery on the coastal streams may be in danger of depletion. Adequate flood control and drainage facilities have neither been constructed nor planned.

In order to analyze the extent of the anticipated water resources related problems, and to evaluate possible solutions to these problems, the Department of Water Resources requested and was appropriated funds from the 1962 Budgetary Session of the State Legislature to begin the Coastal San Mateo County Investigation during the 1962-63 fiscal year. This report presents the results of the investigation.

---

* For the purposes of this report, the San Francisco Bay Area is defined by the nine counties, Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Sonoma, and Solano.

Authorization for Investigation

Specific authorization for the Coastal San Mateo County Investigation is inherent in the appropriation of funds for the 1962-63 fiscal year. General authorization for investigations of this type is contained in Sections 12616 and 12617 of the California Water Code.

Objectives and Scope of the Investigation

The objectives of the Coastal San Mateo County Investigation are: (1), to prepare a comprehensive water resources development plan which will meet the present and future urban and agricultural water requirements of the area, identify existing and foreseeable flood control problems, provide fresh water recreation facilities, and enhance the coastal stream anadromous and fresh water fisheries; (2), to identify those features of the plan for which construction may be economically justified during the next ten years; and (3), to discuss possible methods of financing these justified features.

To accomplish these objectives, studies were directed toward the definition of existing and foreseeable problems related to the water resources of the coastal area of San Mateo County. Definition of these problems included a determination of present and future urban and agricultural water requirements, a review of the occurrence and extent of flooding, preparation of an estimate of the demand for fresh water recreational facilities, and an inventory of the anadromous and fresh water fishery resources of the area.

A solution to the problems of the coastal area required the evaluation of facilities to develop the necessary water supplies and the incorporation of these facilities into a comprehensive plan. The facilities studied included single and multiple-purpose water storage reservoirs, water transportation conduits, and diversion dams. After preparing cost estimates for the facilities under study and estimating the benefits accruing to each project purpose, the features which appeared to maximize net benefits were included in the comprehensive plan.

Financial analysis included the determination of the applicability of various federal and state financing programs to construction of the initial features. The scope of the investigation also allows for the submission of local viewpoints upon alternative project proposals and analysis of these viewpoints to determine their economic justification.

The Area of Investigation

The following sections define the extent of the area covered by the Coastal San Mateo County Investigation, describe the area's geographic characteristics, and outline the history of the area.

the area's geographic characteristics, and outline the history of the area.

Location

The area encompassed by the Coastal San Mateo County Investigation extends from Montara Mountain on the north to the southerly drainage boundary of Finny Creek, which approximates the San Mateo-Santa Cruz County line, on the south. The Pacific Ocean is the western boundary and the eastern boundary is the drainage divide between streams which enter San Francisco Bay and those which enter the Pacific Ocean. The more important drainage subdivisions of the area include San Vicente Creek, Denniston Creek, Frenchmans Creek, Pilarcitos Creek, Purisima Creek, Lobitos Creek, Tunitas Creek, San Gregorio Creek, Pomponio Creek, Pescadero Creek, Butano Creek, Arroyo de los Frijoles, Gazos Creek, Whitehouse Creek, and Ano Nuevo Creek. The area of investigation is indicated on Plate 1, "Area of Investigation and Hydrographic Area Boundaries".

Geographic Characteristics

The surface area covered by the investigation amounts to approximately 265 square miles. The City of Half Moon Bay is the only incorporated area. Smaller communities include Montara, Moss Beach, Princeton, El Granada, San Gregorio, La Honda, Pescadero, and Loma Mar.

The topography of the area consists of a narrow discontinuous strip of gently sloping marine terraces of moderate elevation, intersected by rolling hills which approximate the drainage divides of the major streams. East of the coastal benches the elevation of terrain increases rapidly to the drainage divide between streams which enter San Francisco Bay and the Pacific Ocean. This divide forms a portion of the Santa Cruz Mountains and varies in elevation from 1,000 to 2,500 feet.

The climate of the coastal area of San Mateo County is typical of the central California coast. The frequent fogs that occur during the summer and fall months cause moderate temperatures. Variations of less than 10 degrees in average daily temperature occur between the winter and summer months. The winter months of the coastal area are characterized by storms which move eastwardly from the Pacific Ocean. Mean precipitation varies from about 20 inches per year on the coast to over 50 inches per year at the higher elevations in the Santa Cruz Mountains.

History

The first recorded contact between the coastal area of San Mateo County and the colonizers of the New World occurred in 1769, when Portola, a Spanish explorer, crossed the area while searching for Monterey Bay. His expedition was later credited with the discovery of San Francisco Bay.

During the early 1800's, much of the coastal area was subdivided by Mexican land grants. Later, settlement by Americans occurred and during the 1840's the towns of Half Moon Bay (historically called "Spanishtown") and Pescadero were founded.

When California became a state, most of the area that is now San Mateo County was part of San Francisco County. In 1856 pressure for reform in San Francisco County led to the introduction of a bill in the State Legislature for consolidation of the San Francisco city and county governments. An incidental feature of the bill was the provision for the establishment of San Mateo as a separate county. The measure gained approval and the county was formed. The boundaries of the county were changed in 1868 by annexing the coastal territory between San Gregorio Creek and the existing San Mateo-Santa Cruz County line.

During the late 1800's, the coastal area was rapidly settled by Italian and Portuguese immigrants. These people were probably attracted by the similarity of the coastal climate to their native lands. They brought with them their native talents for growing specialty and common vegetables. By 1900 a thriving agricultural economy existed in the coastal area.

The construction of the Oceanshore Railroad in 1906 was caused by this agricultural growth. The railroad was initially planned to link San Francisco and Santa Cruz. However, the railroad was completed only to Tunitas Creek, which is several miles south of Half Moon Bay. Besides transporting vegetables, the railroad carried tourists and vacationers.

The San Francisco earthquake and fire of 1906 forced thousands of San Francisco residents into San Mateo County. Promoters in the coastal area were quick to take advantage of this event. Land was subdivided and entire towns were laid out, including streets and sidewalks. Much of this development still exists today in El Granada and Montara. The boom, however, was short lived because reconstruction of San Francisco occurred at a much greater rate than the promoters had anticipated. Although many land sales occurred, residential development never really began.

In 1920 the Oceanshore Railroad was abandoned because it was unable to compete with highway transportation. Nevertheless, the recreation and agricultural industries continued to flourish in the coastal area.

Although development in the area of investigation has been very limited since 1920, the southerly movement of urbanization from San Francisco to Daly City and Pacifica is continuing with the result that the Montara-Half Moon Bay area is beginning a new era of growth.

Related Investigations and Reports

A number of reports pertinent to the water resources of the coastal area of San Mateo County have been prepared during the last fifty years. Some of the more important are described in the following sections.

State of California

The State of California, through the Department of Water Resources and its predecessors, has published many reports. These reports include Bulletin No. 5, "Flow in California Streams", published in 1923 by the Department of Public Works, Division of Engineering and Irrigation; Bulletin No. 1, "Water Resources of California", published in 1951 by the State Water Resources Board; Bulletin No. 2, "Water Utilization and Requirements of California", published in 1954 by the State Water Resources Board; Bulletin No. 5, "Santa Cruz-Monterey Counties Investigation", published in 1953 by the State Water Resources Board; and Bulletin No. 3, "The California Water Plan", published in May 1957 by the Department of Water Resources. Bulletins Nos. 1, 2, and 3 were a series and represented a basis for comprehensive development of the State's water resources.

Bulletin No. 5, "Flows in California Streams". This report included publication and analysis of a variety of hydrologic data. When published, this report represented the most comprehensive survey of California water resources ever undertaken.

The streams in the coastal area of San Mateo County were reported upon as part of two stream groups: the Pescadero Creek Group, which included the major coastal streams in San Mateo County north of and including Pescadero Creek but south of Montara Mountain; and the Soquel Creek Group, which included the most southerly of the San Mateo County coastal streams and streams in Santa Cruz County, including the San Lorenzo River. Mean annual flows of 853 acre-feet per year per square mile of drainage area for the Pescadero Creek Group and 864 acre-feet per year per square mile of drainage area for the Soquel Creek Group were shown for the water supply period 1871-72 to 1920-21.

Bulletin No. 1 "Water Resources of California". This report was prepared as an inventory of the water resources of California. The report included an estimate of the mean seasonal runoff for the Pescadero Creek and Scott Creek Stream Groups for the period 1894-95 to 1946-47. The Pescadero Creek Stream Group included that portion of the investigation area north of the Butano Creek watershed. The mean annual runoff for this stream group was estimated to be 706 acre-feet per year per square mile of drainage area. Streams within the coastal area of San Mateo County south of the Butano Creek watershed were included in the Scott Creek Stream Group. Runoff for this group was estimated to be 739 acre-feet per square mile of drainage area.

Bulletin No. 2 "Water Utilization and Requirements of California". This bulletin consisted of an examination of the use of water in California during the period 1945-46 to 1952-53. The coastal area of San Mateo County was placed in Hydrographic Unit 9 of the San Francisco Bay Area.

Applied water requirements in the hydrographic unit were estimated to be 15,200 acre-feet per year and consumptive use requirements were estimated to be 9,400 acre-feet per year. The ultimate water requirements of the area were estimated to be 65,900 acre-feet per year for applied water and 59,600 acre-feet per year for consumptive use. In order to achieve ultimate development, it was also estimated that 47,900 acre-feet per year of supplemental water supply would either have to be developed within the area or imported.

Bulletin No. 5 "Santa Cruz-Monterey Counties Investigation". This report was published in August 1953, as a result of an extensive investigation of the magnitude, utilization, and potential development of the water resources of Santa Cruz County and the Pajaro Valley in Monterey County. Data relative to agricultural water requirements have been useful in the present investigation. Also of interest was the analysis of El Oso Dam and Reservoir, a proposed project within the Waddell Creek Watershed. A minor portion of this watershed is located within San Mateo County, but the stream discharges to the Pacific Ocean from Santa Cruz County just south of San Mateo County.

Bulletin No. 3 "The California Water Plan". This report, which has served as a basic guide to orderly development of the water resources of California, sets forth a general and coordinated plan to meet the ultimate water requirements of the area encompassed by the Coastal San Mateo County Investigation. The plan included Pescadero Reservoir, a 31,000 acre-foot reservoir on Pescadero Creek; Butano Point Reservoir, a 77,000 acre-foot reservoir on Butano Creek; and a water transportation conduit from the reservoir on Butano Creek to the vicinity of Half Moon Bay. The safe yield of these facilities was estimated to be 40,000 acre-feet per year. Operation of the two reservoirs would have been integrated by directing spills from Pescadero Reservoir to Butano Point Reservoir.

U. S. Army Corps of Engineers

The latest published report of the U. S. Army Corps of Engineers relative to the coastal area of San Mateo County is "Appendix C, Water Supply, to the Interim Report on San Francisco Bay Barriers", published in December 1961. This report indicated that in 2020 the Coastal San Mateo County Hydrographic Area would have a water requirement of approximately 50,000 acre-feet per year, based upon a population of 335,000 people with a unit water requirement of 115 gallons per capita per day. The report furtner indicated that this requirement could be met by 6,000 acre-feet per year of water from existing local development and an import of 44,000 acre-feet per year through the Hetch Hetchy system of the City of San Francisco.

The Corps of Engineers is presently making a study on flood control and allied purposes on Pescadero Creek. The study will investigate water resources problems relating to future water supply, recreation, enhancement of fish and wildlife, and flood control.

Soil Conservation Service, U. S. Department of Agriculture

A report entitled, "Soil Survey, San Mateo Area", was issued by the Soil Conservation Service in May 1961. The report consisted of detailed analysis of the soil capabilities of the area covered by the San Mateo County Soil Conservation District, which closely matches the area covered by the Coastal San Mateo County Investigation. The data presented in this report have been extremely useful in carrying out land classification studies for future agricultural development.

City of San Francisco

A report entitled, "The Water Supply of San Francisco", by H. M. Chittenden and A. O. Powell, was prepared in 1912 to guide the development of future water supplies for the City of San Francisco. Included within the report was a plan for development of the Pescadero Creek and San Gregorio Creek Watersheds. This plan consisted of a dam and 75,000 acre-foot reservoir on Pescadero Creek within the Loma Mar Canyon area, a tunnel from San Gregorio Creek to Pescadero Creek, and diversion dams on the upper reaches of Pescadero Creek and San Gregorio Creek which could pass water either to Crystal Springs Reservoir via a gravity pipeline or to the reservoir on Pescadero Creek. The propose development was passed over in favor of the Hetch Hetchy system, but the fact that development of the coastal streams of San Mateo County was considered is significant.

Agricultural Extension Service, University of California

The San Mateo County Farm Advisor published a report in 1956 entitled, "Agriculture, Population Increase, and Water Problems in San Mateo County". This report brought to the attention of many people the realization that a series of water problems might soon exist in the coastal area if immediate action was not taken to plan and construct appropriate facilities. The basic data included in the report has been extremely useful to the present investigation.

San Mateo County

Recently the San Mateo County Planning Commission has published, "Master Plan, San Mateo County, 1961" and "Preliminary General Plan, Mid-Coastside District, San Mateo County". These plans are directed in principle toward the maintenance of the existing "open space" character of the coastal area. This concept, if maintained, will play an important part in the future development of the water resources of the coastal area and demands consideration in the derivation of a comprehensive water resources development plan.

A major highway study was recently completed by San Mateo County. The report on the study, "City-County Highway Plan for San Mateo County", by George S. Nolte Consulting Civil Engineers, Inc., November 1962, includes proposed highway improvements in many of the watersheds suitable for water conservation development.

Other Reports and Studies

Studies of water resources development have recently been conducted by the San Mateo County Flood Control District and the Coastside County Water District.

The study by the San Mateo County Flood Control District was directed toward the formulation of a multiple-purpose project on Pescadero Creek which would include the functions of urban and agricultural water supply, flood control, and recreation The district is interested in developing a project which would include a 25,000 acre-foot reservoir above the County Memorial Park on Pescadero Creek. The report on this proposal has been used as the basis for a request for planning assistance under the provisio of the federal Watershed Protection and Flood Prevention Act.

Studies by the Coastside County Water District were initially directed toward the formulation of a reservoir project on Pilarcitos Creek below the Pilarcitos Reservoir of the City of San Francisco. A preliminary request for state financial assistan under the Davis-Grunsky Act was submitted. A recent review by the district's consulting engineers indicated that the project's economic justification was in question. Further studies concluded that the best approach toward solution of future water supply problems would be the development of Pescadero Creek.

Several other projects are presently under investigation by farmers or subdivision developers for the provision of agricultural or urban water supplies. These projects, however, involv only small drainage areas and reservoir storage capacities.

CHAPTER II. PRESENT AND PROJECTED RESOURCES DEVELOPMENT

The coastal area of San Mateo County is relatively close to many of the commercial and industrial centers of the San Francisco Bay Area. In spite of this fact, the area has only begun to participate in the population growth of the Bay area. All present indications, however, lead to the conclusion that only a few years separate the coastal area from rapid population growth.

Until urban development has been completed in the coastal area, the existing agricultural economy can at least be sustained, if not expanded. An already flourishing recreation industry also has considerable potential for expansion.

For the purpose of studying the various components of resources development, the area of investigation has been subdivided into several primary and secondary hydrographic areas. Their names and acreages are given in Table 1 and their boundaries are indicated on Plate 1.

Urban Development

A primary factor which must be considered in the comprehensive planning of an area's water resources is the extent and rate of the future growth of the area's urban economy. This condition is particularly true in areas which are within or adjacent to the San Francisco Bay Area. In most of these areas, it is the urban economy which will represent the major use of water and which will be most affected economically by physical solutions to flood control problems and by the provision of recreation and fishery enhancement facilities.

TABLE 1

HYDROGRAPHIC AREAS
WITHIN THE COASTAL SAN MATEO COUNTY AREA

Hydrographic Area			Area (acres)	
Number		Name		
I.		Montara-Moss Beach		7,895
II.		Half Moon Bay		
	A.	Northern Subarea	5,620	
	B.	Pilarcitos Creek Watershed	18,350	
	C.	Southern Subarea	3,800	
		Area Total		27,770
III.		Middle Coastal		17,630
IV.		San Gregorio Creek		33,560
V.		Pomponio Creek		5,640
VI.		Pescadero-Butano Creeks		
	A.	Pescadero Creek Watershed	38,440	
	B.	Butano Creek Watershed	13,730	
	C.	Coastal Subarea	6,980	
	D.	Gazos Creek Watershed	7,380	
		Area Total		66,530
VII.		Ano Nuevo		10,410
		Investigation Area Total		169,435

The coastal area of San Mateo County is no exception to these conditions. Ultimately, the area will probably be integrated into the San Francisco Bay Area urban economy. The exact rate of this integration can only be estimated at this time. However, every indication leads to the conclusion that only a few years separate the coastal area from rapid urban development. Therefore, proper planning for the development of the area's water resources is mandatory.

Urban Development of the San Francisco Bay Area

Urban development of the coastal area of San Mateo County is dependent upon continued economic development of the San Francisco Bay Area. Studies of Bay area development have been numerous and include those of the Bay Area Rapid Transit Commission, the U. S. Department of Commerce, and the Department of Water Resources. The results of these studies generally agree that the economy of the Bay area will continue to grow, providing national and state economic growth continues.

An estimate of the magnitude of the economic growth of the Bay area was recently published by the Department of Water Resources in "Delta Water Requirements Appendix to Bulletin No. 76, Delta Water Facilities". A reflection of this growth is shown by the historical and projected population of the Bay area presented in Table 2.

TABLE 2

HISTORICAL AND PROJECTED POPULATION OF THE SAN FRANCISCO BAY AREA AND SAN MATEO COUNTY

Year	San Francisco Bay Area population	San Mateo County	
		Population	Percent of S.F. Bay Area population
1900	658,000	12,100	1.8
1910	927,000	26,600	2.9
1920	1,184,000	36,800	3.1
1930	1,576,000	77,400	4.9
1940	1,733,000	111,800	4.9
1950	2,681,000	235,700	8.8
1960	3,639,000	444,400	12.2
1970	4,900,000[a]	648,000[b]	13.2
1980	6,200,000[a]	812,000[b]	13.1
1990	7,600,000[a]	933,000[b]	12.3
2000	9,050,000[a]	1,018,000[b]	11.2
2010	10,490,000[a]	1,093,000[b]	10.4
2020	11,900,000[a]	1,163,000[b]	9.8

a. From Table 4, "Delta Water Requirements Appendix to Bulletin No. 76, Delta Water Facilities", Department of Water Resource February 1962.

b. Estimated by the Department of Water Resources.

Estimates prepared by the California Department of Finance indicate that the July 1963 population of the Bay area had risen to 4,078,800 people. This level of population is approximately that interpolated from Table 2 for this date.

Doubling the population of the Bay area by 1990 and tripling by 2020 will cause changes in all presently undeveloped areas such as the coastal area of the San Mateo County.

Urban Development of San Mateo County

The historical economic development of San Mateo County has been somewhat faster than, but closely parallel to, that of the San Francisco Bay Area. Rapid population growth has occurred and many industrial and commercial centers have been constructed within the county. However, urbanization has been almost completely limited to the bayside and the northern areas of the county. Historical population development of San Mateo County is indicated in Table 2.

Future population growth of San Mateo County will result not only from expansion of the industrial and commercial centers already established in the county, but also from the expansion of similar centers in San Francisco, Santa Clara and Alameda Counties. San Mateo County serves, and will continue to serve, as a "bedroom area" to these centers. This position is primarily the result of the excellent transportation facilities available between these centers and the northern and bayside areas of the county.

The significance of San Mateo County as a "bedroom area" is exemplified by recent statistics compiled by the Stanford Research Institute for the report, "City-County Highway Plan for San Mateo County," by George S. Nolte, Consulting Civil Engineers, Inc. These statistics indicated that in 1960 nearly 45 percent of the employed resident population of San Mateo County was employed in other Bay area counties. This commuting labor force was partially offset by similar commutation to San Mateo County from other counties equal to about 15 percent of the San Mateo County labor force. These same studies indicated that future development of San Mateo County would involve continued growth of the existing commuting labor force, although growth of the resident employment would be at a faster rate.

The concept that San Mateo County can serve as a population center for the economic development of adjacent counties has a direct bearing on the future development of the county. It means that the main requirement for population growth in San Mateo County is continued economic development of the San Francisco Bay Area.

Future population development in San Mateo County, under present land use patterns, is limited to a probable level of about 1,500,000. As the county population approaches this level, it can be anticipated that the rate of population growth will be gradually reduced. The primary demand for development of the county will occur in the northern and bayside areas. Therefore, these areas will probably reach a condition of near maximum development well before the coastal area. The attainment of this condition will also place a restriction on the rate of population growth within the county.

It can be concluded that the following three factors affect the rate of population growth within San Mateo County: (1) the overall economic development of the San Francisco Bay Area; (2) the county population as a function of its estimated maximum population; and (3) the population of the northern and bayside areas of the county as related to their estimated maximum populations. An analysis of these factors indicates that the rate of population growth in San Mateo County, as related to that of the San Francisco Bay Area, will be reduced gradually during succeeding decades because of the unavailability of suitable land. Table 2 shows the estimated future population of San Mateo County.

The population estimates for San Mateo County used in this report were compared to recent estimates by other organizations such as the U. S. Department of Commerce and the San Mateo County Planning Commission. The comparison indicates only minor differences exist among the estimates.

Urban Development of the Investigation Area

As stated earlier, the coastal area of San Mateo County, south of Montara Mountain, has not yet begun significant participation in the rapid economic development of the San Francisco Bay Area and San Mateo County. There are three readily apparent reasons for this lag.

The first, and perhaps most important, reason for the lack of development is the location of considerable land suitable for urban uses between the coastal area and the commercial and industrial centers of the Bay Area. This land, which is located in the northern and bayside areas of San Mateo County, is rapidly being developed.

A second reason for lack of development is the geographic barrier (the Santa Cruz Mountains) lying north and east of the coastal area. This barrier has delayed the construction of major transportation arteries. Urban development in the Bay Area has often tended to parallel these arteries. Rapid and safe highway facilities are a prime requirement for the development of "bedroom areas."

The third reason for lack of development is the absence of major industries other than agriculture and recreation. This is partially caused by inadequate transportation facilities and the availability of suitable land elsewhere. Other factors affecting industrial location in the coastal area are unfavorable compared with the Bay area.

The coastal area has experienced some urban development, however, its growth rate has been very small when compared to that of the San Francisco Bay Area. The following sections outline the past and present population of the area and describe the extent of the present urband land use.

Exact past populations of the investigation area are difficult to determine. Populations have been reported for the Half Moon Bay Township, which generally matches the boundaries of the investigation. The main area excluded by the township boundary lies along the eastern part of the study area adjacent to Skyline Boulevard. Past populations of the township are indicated in Table 3.

TABLE 3

HISTORICAL POPULATION OF THE HALF MOON BAY TOWNSHIP

Year	Population
1910	2,939
1920	3,140
1930	3,438
1940	3,937
1950	4,024
1960[a]	7,235

a. Estimated from census district information.

In 1960 the census districts were sufficiently detailed to give a better estimate of the area population. This detailed census also allowed an accurate distribution of the population among the hydrographic areas. Table 4 summarizes the 1960 population distribution and shows the total investigation area population.

TABLE 4

ESTIMATED DISTRIBUTION OF THE 1960 COASTAL AREA
POPULATION AND 1962 URBAN LAND USE

Hydrographic area Number	Hydrographic area Name	Estimated 1960 population		1962 urban land use (acres)
I	Montara-Moss Beach		1,405	931
II	Half Moon Bay			
	A Northern Subarea	1,763		
	B Pilarcitos Creek Watershed	1,053		
	C Southern Subarea	863		
	Area Total		3,679	799
III	Middle Coastal		424	24
IV	San Gregorio Creek		1,067	125
V	Pomponio Creek		40	-
VI	Pescadero-Butano Creeks			
	A Pescadero Creek Watershed	776		
	B Butano Creek Watershed	40		
	C Coastal Subarea	75		
	D Gazos Creek Watershed	20		
	Area Total		911	151
VII	Ano Nuevo		109	16
	Investigation Area Total		7,635	2,046

An inventory of the use of land for urban purposes was included in a land use survey made in the fall of 1962. This survey, which included most of the agricultural lands in the investigation area, will be discussed in the sections on agricultural development. The results concerning the urban portion of the inventory are shown in Table 4. The areal distribution of present urban lands is shown on Plate 2, "Urban, Irrigated, and Irrigable Lands in 1962".

Projected Urban Development of the Investigation Area

Changes in the present patterns of urban development in the coastal area depend on changes in the conditions that have prevented participation in Bay area growth. The modification of many of these previously discussed conditions may soon be undertaken. For example, the availability of land between the coastal area and the Bay area industrial and commercial centers is rapidly diminishing. The available land will, in many cases, have high development costs. Thus, pressures to urbanize the coastal area already exist because of lack of competitively developable land in more accessible locations.

The lack of adequate intercity transportation facilities through the geographical barriers to the north and east of the coastal area will be overcome. Considerably improved highway facilities are expected to be available soon. These improvements will include development of State Highway No. 105 from Belmont to Half Moon Bay as a four or six-lane freeway and the replacement of the dangerous Devils Slide section of State Highway No. 1 between Pacifica and Montara with a four-lane freeway. Additional highway improvements affecting the coastal area include construction of the Junipero Serra Freeway, extension of the 19th Avenue Freeway from San Mateo to Crystal Springs Reservoir, and the possible improvement of roads from Redwood City and Palo Alto into the southern part of San Mateo County.

The Division of Highways does not have an exact time schedule for these improvements. For the purpose of this report it has been assumed that the 19th Avenue Freeway will be completed by 1965, the improvements from Pacifica to Montara by 1975, and the improvements from Belmont to Half Moon Bay by 1980. The other improvements will be completed after 1985.

When State Highway No. 1 reaches full freeway status, the coastal area will be intersected by a major highway. Ultimately, a major industrial and commercial area may exist on Monterey Bay and the coastal freeway could well serve as a major connection between this area and the San Francisco Bay Area. This could lead to a variety of developments in the coastal area of San Mateo County.

One such development could occur in the area adjacent to the Half Moon Bay Airport. This airport may be expanded and modernized. This modernization would make the airport advantageous for air freight carriers and would undoubtedly make adjacent lands highly desirable for industries requiring airport facilities.

While there is a good possibility of commercial development in the area adjacent to the Half Moon Bay Airport, large scale development of manufacturing industries does not appear likely. There is an excellent possibility of recreation industry expansion, particularly if major water resources development is undertaken. If this water resources development provides for additional firm agricultural water supplies, there could be an expansion of the area's agricultural industry during the next several decades.

Although urban pressures will be generated by the expansion of the recreation and agriculture industries, the main pressures for urbanization of the coastal area will result from commercial and industrial development in other areas. The main economic support necessary for urban development will be from outside the area and the coastal area of San Mateo County will develop as a "bedroom area". This conclusion is supported by an analysis of the economic characteristics of the City of Pacifica, a rapidly growing urban community in San Mateo County just north of the investigation area. The analysis indicated that over 60 percent of the employed resident population of Pacifica were employed outside San Mateo County.

On the basis of the previous considerations, the population of the coastal area was projected to increase only moderately from the present until 1970. The completion of improved highway facilities will probably lead to very rapid population growth during the decade from 1970 to 1980. After 1980, the population growth rate will probably remain relatively constant.

To evaluate future water requirements, the projected population estimates must be distributed by hydrographic areas. It was assumed that until 1980 the majority of the population increases would occur either within or north of Half Moon Bay. After 1980, development would probably extend along La Honda Road into the San Gregorio Creek and Pescadero Creek Watersheds.

As the areas in the north approach ultimate development, new development will probably advance down the coast highway to the San Gregorio Valley. Population growth south of San Gregorio will be moderate, although the Ano Nuevo area may develop as a result of the presence of the Santa Cruz campus of the University of California.

The projected populations and their distribution by hydrographic areas are presented in Table 5.

Maximum Urban Development of the Investigation Area

If development of the water resources of the coastal area is considered as the means of water supply, estimates of the maximum demand for water must be made so that projects to conserve the required supplies can be planned and the most favorable sites for development can be protected from urban encroachment. As a basis for estimating maximum water requirements, it has been assumed that: (1) a large part of the coastal area will be urbanized; (2) there will be no agricultural development; and (3) those lands not urbanized will have low population densities and will be primarily used for recreation. The assumption was also made that the urbanized areas will not have high density use and the existing "open space" character of the coastal area will be preserved.

TABLE 5

DISTRIBUTION OF PROJECTED FUTURE POPULATION IN THE COASTAL AREA OF SAN MATEO COUNTY

Hydrographic Area Number	Hydrographic Area Name	Year 1970	1980	1990	2000	2010	2020	Estimated Maximum
I	Montara-Moss Beach	3,000	10,000	13,500	16,000	18,000	19,000	20,000
II	Half Moon Bay	7,000	25,500	35,000	40,000	44,000	47,000	48,000
III	Middle Coastal	500	2,500	6,500	14,000	20,000	26,000	27,000
IV	San Gregorio Creek	1,500	2,900	4,500	6,100	7,700	9,300	17,800
V	Pomponio Creek	100	100	200	300	400	500	8,000
VI	Pescadero-Butano Creeks	1,100	1,500	2,300	3,100	3,900	4,700	58,300
VII	Ano Nuevo	200	500	1,000	1,500	2,000	2,500	18,900
	Unallocated[a]	600	1,000	3,000	5,000	7,000	9,000	40,000
	Investigation Area Total	14,000	44,000	66,000	86,000	103,000	118,000	238,000

[a] Unallocated population will occur in areas not covered by the land class survey, generally adjacent to Skyline Boulevard.

The area considered for maximum urban development closely approximates the limits (generally lands below the 500-foot contour) of a land classification study made in 1963. Exceptions to this limitation would occur along major roads through or adjacent to the investigation area such as Skyline Boulevard and La Honda Road.

To estimate the ultimate population of the area covered by the land classification survey, unit densities were applied to the various land classes. Densities of 8, 6, and 4 people per acre for the northern two-thirds of the investigation area and densities of 7, 5, and 3 for the southern third were applied to the "V", "H", and "M", land classes, respectively. The lower densities were applied to the southern third of the area in the belief that more of its "open space" character will be preserved than in the northern portion. Areas not included in the land classification survey were estimated to be capable of supporting a population of 40,000. Most of this addition population would be adjacent to Skyline Boulevard. The estimated maximum population of the coastal area of San Mateo County is 238,000.

AGRICULTURAL DEVELOPMENT

Historically, agriculture has had an important part in the economy of San Mateo County. Since the end of World War II, the rapid urbanization of the bayside area of San Mateo County has decreased the size of the overall county agricultural economy. In the coastal area, however, agriculture continues to flourish, particularly the production of specialty crops such as Brussel sprouts and artichokes, which are peculiarly adapted to the climate of the area. Population projections indicate that the ultimate use of the lands of the coastal area will be urban. Before this urbanization is completed, maintenance and expansion of irrigated agriculture in the coastal area must be considered as advantageous to the overall economy of the county.

Past and Present Agricultural Development

The earliest agricultural enterprises in San Mateo County probably consisted of cattle raising during the Spanish and Mexican periods. As the population of San Francisco County grew and transportation facilities were improved, San Mateo County became a natural supplier of garden vegetables. By the beginning of the present century, intensive production of such crops as peas, potatoes, and cabbage had begun. Peak utilization of land for crop production, in terms of acreage, was apparently reached around 1925. Reductions in agricultural land use since that year have been due, in part, to the urbanization of farm land and to improper cultural practices which resulted in heavy sheet erosion. Accurate statistics for irrigated agricultural land use prior to 1941 are not available. Statistics have been compiled by the San Mateo County Department of Agriculture since 1941. These statistics and other related data on the utilization of agricultural land in San Mateo County are shown in Table 6.

TABLE 6

HISTORICAL AGRICULTURAL LAND USE IN SAN MATEO COUNTY

(Acres)

Year	Crop and acreage				Total crop-land area	Pasture area	Total agricul-tural area	Source of data[a]
	Truck crops	Field flowers	Field crops	Fruit and nuts				
1909	3,648[b]							1
1919	7,142[b]						77,736	1
1930	9,180[c]							2
1941	11,963	1,135	23,704	623	37,425			3
1945	11,726	887	26,596	528	39,737			3
1946	9,982	1,123	21,581	521	33,207			3
1948	7,583	1,295	27,845	481	37,204			3
1952	6,058	1,367	23,044	397	30,866			3
1954	6,335	1,279	23,995	378	31,987			3
1955	5,739	1,234	24,681	380	32,034			3
1956	5,593	1,280	23,128	428	30,429			3
1957	5,734	1,146	23,623	397	30,900			3
1958	5,067	1,119	19,185	381	25,752			3
1959	4,837	1,004	18,576	382	24,799	33,131	57,930	3
1960	4,653	921	17,932	350	20,856	35,904	56,760	3
1961	3,880	894	16,778	283	21,835	35,760	57,595	3
1962	3,837	780	15,090	279	19,986	38,725	58,711	3

a. Sources of data:
   (1) 1920 census, Volume VII, Irrigation and Drainage
   (2) 1940 census, Irrigation of Agricultural Lands
   (3) Annual reports of the San Mateo County Department of Agriculture
b. Represents total irrigated area. May include crops other than truck.
c. Represents irrigable land for all irrigated crops.

Although the data presented in Table 6 is for all of San Mateo County, the coastal area has always had a major role in the agricultural economy of the county. The earliest statistics on the coastal area's share of agricultural land usage found during the investigation were for 1949. At that time, it was estimated that about 70 percent of the county's irrigated acreage was in the coastal area. A 1958 study by the U. S. Army Corps of Engineers resulted in a similar percentage. The most recent statistics indicate that the coastal area now contains over 80 percent of the irrigated agricultural land within the county.

The land use survey, made in the fall of 1962, was used as a base for projections of future crop patterns in the coastal area. This survey was generally confined to lands below the 500-foot elevation. This limitation was used because present agricultural activities above that elevation are mostly confined to dry farming and the potential for irrigation is severely limited by steep slopes and high water costs. The results of the land use survey are presented in Table 7. The areal extent of irrigated lands in 1962 is shown on Plate 2.

AGRICULTURAL LAND USE IN THE COASTAL AREA OF SAN MATEO COUNTY
(Acres)

Hydrographic area and subarea number[a]	Irrigated lands								Non-irrigated field crops[b]
	Vegetable crops			Other crops				Total	
	Artichokes	Brussels sprouts[c]	Misc.	Flowers	Strawberries	Pasture	Misc.		
I	22	210	257	120	3	34		646	250
II-A		117	36	159		12		324	69
II-B	109	254	34	220	4	128		749	109
II-C	135	155	89	10				389	1,264
AREA II Total	244	526	159	389	4	140		1,462	2,424
III	58	177	41	4		6		286	2,205
IV	87	56	32			152	21	348	399
V			6			130		136	1,216
VI-A	115		145	72		193	12	537	1,932
VI-B	93	5	60	23		161		342	1,294
VI-C	40	564	148	41		53		846	2,693
VI-D		1						1	253
AREA VI Total	248	570	353	136	0	407	12	1,726	6,172
VII	103	423	223	9	71	6		835	1,520
Investigation Area Total	762	1,962	1,071	658	78	875	33	5,439	14,186

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a. For name and location of areas and subareas see Table 1 and Plate 2.
b. Includes areas of irrigated land in rotation.
c. Includes all Cole crops.

Projected Agricultural Development

The continuation of agriculture as a significant part of the economy of San Mateo County depends on maintenance of the existing irrigated acreages and on the irrigation of lands presently used for dry farming. Projections of future populations in the coastal area indicate that the northern part of the area may be completely urbanized by the year 2020. The projections for the southern part of the area indicate that urbanization will not be complete for several decades after the year 2020. Maintenance of the agricultural economy will require continued agricultural use of the lands presently devoted to farming and the development of additional lands to offset urbanization in the north.

Before future agricultural crop patterns can be projected, the physical potential for the irrigation of new lands must be known. This information was obtained from a land classification survey made during the fall of 1962 and the spring of 1963. This survey was generally confined to the limits of the land use survey previously described. The results of the survey are presented in Table 8. An explanation of the land classification symbols is given in Table 9.

TABLE 8

CLASSIFICATION OF IRRIGABLE LANDS IN THE COASTAL AREA OF SAN MATEO COUNTY
(Acres)

Hydrographic area number	Irrigable land classes[a]									
	V	Vp	Vh	Vw	H	Hp	Hw	M	Mp	Total
I	301	373		17	181	608	19	8	558	2,065
II-A	292	253			149	240			543	1,477
II-B	638	313			454	347			980	2,732
II-C	58	1,173	122	3		656			390	2,402
AREA II Total	988	1,739	122	3	603	1,243			1,913	6,611
III	82	435			188	1,905	9	6	2,450	5,075
IV	215	48	136		229	1,044		6	2,595	4,273
V	52	19			249	381		11	1,451	2,163
VI-A	973			4	239	801		3	1,919	3,939
VI-B	708	60		62	38	321		11	916	2,116
VI-C	109	940		22	77	2,608		65	943	4,764
VI-D	5	3				241			173	422
AREA VI TOTAL	1,795	1,003		88	354	3,971		79	3,951	11,241
VII	486	1,076[b]		26	99	1,083	15	3	490	3,278
Investigation Area Total	3,919	4,693	258	134	1,903	10,235	43	113	13,408	34,706

a. For explanation of land classification symbols see Table 9.
b. Includes 21 acres of land classified as Vl.

TABLE 9

LAND CLASSIFICATION LEGEND

Land class symbol	Characteristics
V	These lands are level or slightly sloping and vary from smooth to hummocky or gently undulating relief. The maximum allowable slope is 6 percent for smooth reasonably

TABLE 9

LAND CLASSIFICATION LEGEND (Continued)

Land class symbol	Characteristics
V(Continued)	large-sized bodies lying in the same plane. As the relief increases and becomes more complex, lesser slopes are limiting. The soils have medium to deep effective root zones, are permeable throughout, and free of salinity, alkalinity, rock, or other conditions limiting crop adaptability of the land. These lands are suitable for all climatically adapted crops.
H	These are lands with greater slope and/or relief than those of the V class. They vary from smooth to moderately rolling or undulating relief. The maximum allowable slope is 20 percent for smooth, reasonably large-sized bodies lying in the same plane. As the relief increases and becomes more complex, lesser slopes are limiting. The soils are permeable, with medium to deep effective root zones, and are suitable for the production of all climatically adapted crops. The only limitation is that imposed by topographic conditions.
M	These are lands with greater slope and/or relief than those of the H class. They vary from smooth to steeply rolling or undulating relief. The maximum allowable slope is 30 percent for smooth, reasonably large-sized bodies lying in the same plane. As the relief increases and becomes more complex, lesser slopes are limiting. The soils are permeable with medium to deep effective root zones, and are suitable for the production of all climatically adapted crops. The only limitation is that imposed by topographic conditions.
Any variation from the foregoing, as defined, is indicated by use of one or more of the following symbols:	
p	Indicates shallow depth of the effective root zone, which in general limits use of these lands to shallow-rooted crops.
w	Indicates the presence of a high-water table, which in effect limits the present crop adaptability of these lands to pasture crops. Drainage and a change in irrigation practice would be required to affect the crop adaptability.
l	Indicates fairly coarse textures and low moisture holding capacities, which in general make these lands unsuited for production of shallow-rooted crops because of the frequency of irrigations required to supply the water needs of such crop
h	Indicates very fine textures, which in general make these land best suited for production of shallow-rooted crops.

From Table 8, irrigation potential can be estimated by applying factors representing the percentage of suitable land which could practicably be included in farm enterprises. The net irrigable acreage for each subarea was estimated by assuming that 93 percent of all lands classed within the "V" category and 75 percent of those within the "H" category would be utilized. These factors are based on data for more developed areas of similar terrain. Computation results and the acreages presently irrigated (taken from the land use survey) are given for each hydrographic area in Table 10. The maximum potential for new land development is also shown. Areal distribution of irrigable lands and of presently irrigated lands is shown on Plate 2.

The information presented in Table 10 represents the maximum practicable extent of irrigated development. Preliminary studies of demand for specialty crops grown in the coastal area indicated that Brussels sprouts production will be the major contributor to the agricultural economy in the future. Because Brussels sprouts production is severely limited by climate and because there are indications that production mechanization will increase, additional studies were made to define areas suitable for Brussels sprouts production. Climatic and mechanization requirements limit production to lands located within one-half mile of the coast which have a maximum slope of 16 percent. The eastern limit of the favorable climatic zone is shown on Plate 2. The acreages suitable for Brussels sprouts production in Hydrographic Areas III through VII are presented in Table 11. Areas I and II were not included in this study because early urbanization will preclude new irrigation development.

TABLE 10

LAND DEVELOPABLE FOR IRRIGATION IN THE COASTAL AREA OF SAN MATEO COUNTY (Acres)

Hydrographic area Number	 Name	Irrigable lands	Presently Irrigated lands	Potential acreages for new development
I	Montara-Moss Beach	1,219	646	573
II	Half Moon Bay			
	A Northern Subarea	799	324	475
	B Pilarcitos Creek Watershed	1,485	749	736
	C Southern Subarea	1,750	389	1,361
	Area Total	4,034	1,462	2,572
III	Middle Coastal	2,050	286	1,764
IV	San Gregorio Creek	1,326	348	978
V	Pomponio Creek	539	136	403
VI	Pescadero-Butano Creeks			
	A Pescadero Creek Watershed	1,685	537	1,148
	B Butano Creek Watershed	983	342	641
	C Coastal Subarea	2,989	846	2,143
	D Gazos Creek Watershed	188	1	187
	Area Total	5,845	1,726	4,119
VII	Ano Nuevo	2,340	835	1,505
	Investigation Area Total	17,353	5,439	11,914

TABLE 11

LANDS SUITABLE FOR BRUSSELS SPROUTS PRODUCTION IN THE COASTAL AREA OF SAN MATEO COUNTY (Acres)

Hydrographic area Number	 Name	Brussels sprouts lands	
III	Middle Coastal		1,049
IV	San Gregorio Creek		203
V	Pomponio Creek		147
VI	Pescadero Butano Creeks		
	A Pescadero Creek Watershed	583	
	B Butano Creek Watershed	201	
	C Coastal Subarea	1,946	
	D Gazos Creek Watershed	50	
	Area Total		2,780
VII	Ano Nuevo		1,850
	Total-Areas III through VII[a]		6,029

[a] Areas I and II excluded due to early urbanization.

Once the physical potential for agricultural development has been defined, the next step is to evaluate the market demand for the crops likely to be grown in the area. Specialty crops of Brussels sprouts, artichokes, flowers, and miscellaneous truck crops have accounted for most of the irrigated land use in the investigation area. To project future crop patterns, market demand studies were made for Brussels sprouts, artichokes, and flowers.

In making the market demand study, historical data on total production, per capita production, acreage in production, yields per acre, and percent of total production supplied by California, San Mateo County, and the coastal area were analyzed for Brussels sprouts and artichokes. Projections of per capita and total production, yields per acre, and the California and San Mateo County share of the total production were made to the year 2020. Data used and assumptions made are discussed in the following paragraphs.

Brussels sprouts are a high value specialty crop particularly suited to the climate and soils of the coastal portion of the investigation area; therefore, detailed studies were made of this crop.

Per capita production of Brussels sprouts has increased from 0.28 pounds in 1942-45 to 0.39 pounds in 1959-62. This is an average annual rate of increase of about 1.75 percent. Although some believe that per capita production is approaching the saturation level, the existence of an active sales campaign by the Growers Association, an increased emphasis on processed and frozen methods of marketing, and an increase in per capita disposable income leads to the conclusion that per capita production will increase. For this study, it was assumed that per capita production would increase to 0.50 pounds in 1990 and to 0.60 pounds in 2020. This is an average annual rate of increase of less than 1 percent.

Average yields per acre in California have increased from 4.4 tons in 1949-51 to 6.2 tons in 1961-63; an average annual rate of increase of 3 percent. The projection of future yields is complicated by the scheduled termination of the Bracero program (Public Law 78). Some of the growers have considerable doubts about their ability to continue production without Bracero labor. Consultation with farm advisors and other agricultural authorities led to the conclusion that after a period of adjustment and experimentation, successful adaptation of mechanical means of production (mainly harvesting) would take place.

To establish a basis for projecting future yields, three assumptions were made. The assumptions are: (1) mechanical methods of cultivation and harvesting will be successfully introduced and applied to replace the hand labor currently used; (2) new varieties currently being developed will give "one-time harvesting" yields comparable in quality and quantity with those realized under present conditions; and (3) improvement in cultural practices relating to plant spacing, fertilization, and disease and insect control will be important factors in increasing yields in the future. Considering these assumptions, yields were projected to increase to 7.0 tons per acre in 1970, 8.5 tons per acre in 1990, and 11.0 tons per acre in 2020. The projected average annual rate of increase is less than 1.0 percent.

Historically, California has averaged about 90 percent of the total United States production of Brussels sprouts. In 1962, California's share of the market was 93 percent. Although Long Island, New York, is a producing area, primarily serving fresh markets in the east, and Oregon and Washington have some potential areas, none of the information obtained has indicated that California's share of the market will decrease in the future. California's share of the market was held at 93 percent to the year 2020.

San Mateo County's share of California Brussels sprouts production has averaged about 43 percent. Santa Cruz and Monterey Counties have the other major production areas. Although the State Brussels Sprouts Marketing Order, which effectively limits total production, is given to the individual grower and does not attach to the land, there appears to be no reason for growers to change areas if adequate supplies of irrigation water are available. San Mateo County's share of total California acreage is assumed to remain between 40 and 42 percent to the year 2020.

The acreage required to produce both the California and the coastal areas annual share of the market demand was determined, based on the above considerations. The required acreages are shown in Table 12.

TABLE 12

BRUSSELS SPROUTS ACREAGE IN CALIFORNIA AND THE COASTAL AREA OF SAN MATEO COUNTY REQUIRED TO MEET THE MARKET DEMAND

(acres)

Year	California	Coastal area of San Mateo County
1962	5,300	2,200
1970	6,000	2,400
1980	7,300	2,900
1990	7,900	3,200
2000	9,200	3,900
2010	9,900	4,100
2020	10,700	4,500

The figures in Table 12 represent the acreage which could be supported by the projected market demand for Brussels sprouts. The data presented in Table 11 indicates that sufficient land to meet the market demand is available. There are, however, two significant factors which are not considered in determining market demand. These factors are the necessity for crop rotation and the urbanization of lands suitable for Brussels sprouts production.

Brussels sprouts are usually grown on a given area for two years and then a rotation crop is grown for two years. The rotation crops are generally barley, peas, or to some extent, flowers. It is necessary, therefore, to have two acres of suitable land to have one acre in continuous production. This rotation requirement will be reflected in the crop pattern projections presented later in this section.

As previously stated, the urbanization of agricultural lands will have a major influence on the amount of land in agricultural production. Allowances for lands withdrawn from agriculture for urban use have been included in the projection of future crop patterns.

Artichoke production requires good deep soil, but suitable land is severely limited in the coastal area and is expected to decrease rapidly with increases in urban development. The per capita production of artichokes has remained relatively constant at 0.25 pounds from 1940 to 1962. Yields have increased at an average annual rate of 2.5 percent during this same period. For the initial market demand study, per capita production was projected at 0.25 pounds to 2020 and the average annual rate of increase in yield was estimated to be 1.5 percent. This rate would hold the total California acreage at the 1962 level. Under these assumptions, the coastal area share of production would remain at 700 acres. Urban encroachment would reduce this share to 600 acres in 1990 and 425 acres in 2020.

Several other crops were considered in the market demand study. Flowers, strawberries, and pasture acreages were assumed to remain relatively constant throughout the period of analysis. The miscellaneous truck crops, such as peas and spinach, are used as rotational crops with Brussels sprouts and are expected to parallel sprouts production. Barley acreage is expected to increase, paralleling Brussels sprouts, becuase it is considered an ideal rotation crop for controlling the clubroot disease associated with Brussels sprouts production.

Projections of future crop patterns were made for the investigation area. The results of the market demand studies and consideration of the effects of urbanization on lands suitable for agriculture were used in making these projections. The projected crop patterns are the basis for estimates of the agricultural water requirements of the investigation area and are presented in Table 13.

TABLE 13

PROJECTED CROP PATTERNS FOR THE COASTAL AREA OF SAN MATEO COUNTY 1962-2020

(acres)

Year	Arti-chokes	Brussels sprouts	Misc. truck	Flowers	Straw-berries	Pasture	Other (barley)	Total irri-gated
Montara-Moss Beach Hydrographic Area								
1962	22	210	257	120	3	34	0	646
1970	10	150	160	100	0	25	0	445
1980	0	50	50	80	0	0	0	180
1990	0	0	0	50	0	0	0	50
2000	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
Half Moon Bay Hydrographic Area - Northern Subarea								
1962	0	117	36	159	0	12	0	324
1970	0	100	25	75	0	0	0	200
1980	0	0	0	50	0	0	0	50
1990	0	0	0	25	0	0	0	25
2000	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
Half Moon Bay Hydrographic Area - Pilarcitos Creek Watershed								
1962	109	254	34	220	4	128	0	749
1970	80	215	30	175	0	60	50	610
1980	0	50	0	100	0	0	0	150
1990	0	0	0	75	0	0	0	75
2000	0	0	0	50	0	0	0	50
2010	0	0	0	25	0	0	0	25
2020	0	0	0	0	0	0	0	0
Half Moon Bay Hydrographic Area - Southern Subarea								
1962	135	155	89	10	0	0	0	389
1970	120	135	80	0	0	0	50	385
1980	50	70	50	0	0	0	25	195
1990	0	50	0	0	0	0	0	50
2000	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
Half Moon Bay Hydrographic Area - Total								
1962	244	526	159	389	4	140	0	1,462
1970	200	450	135	250	0	60	100	1,195
1980	50	120	50	150	0	0	25	395
1990	0	50	0	100	0	0	0	150
2000	0	0	0	50	0	0	0	50
2010	0	0	0	25	0	0	0	25
2020	0	0	0	0	0	0	0	0
Middle Coastal Hydrographic Area								
1962	58	177	41	4	0	6	0	286
1970	60	180	50	10	0	10	100	410
1980	80	400	75	20	0	10	150	735
1990	80	300	75	20	0	10	150	635
2000	60	180	75	20	0	10	100	445
2010	25	40	0	5	0	10	30	110
2020	0	0	0	0	0	0	0	0
San Gregorio Creek Hydrographic Area								
1962	87	56	32	0	0	152	21	348
1970	90	70	40	20	0	160	60	440
1980	100	70	50	20	0	200	70	510
1990	100	70	70	20	0	200	70	530
2000	100	60	60	20	0	175	60	475
2010	75	50	50	10	0	140	30	355
2020	70	40	40	10	0	140	25	325

Year	Arti-chokes	Brussels sprouts	Misc. truck	Flowers	Straw-berries	Pasture	Other (barley)	Total irri-gated
Pomponio Creek Hydrographic Area								
1962	0	0	6	0	0	130	0	136
1970	0	35	10	10	10	135	30	230
1980	50	60	20	10	15	140	50	345
1990	25	60	40	10	20	140	50	345
2000	0	60	45	10	20	140	50	325
2010	0	60	50	10	20	130	60	330
2020	0	50	50	10	20	130	50	310
Pescadero-Butano Creeks Hydrographic Area - Pescadero Creek Watershed								
1962	115	0	145	72	0	193	12	537
1970	115	70	160	100	0	200	60	705
1980	125	275	180	125	0	210	120	1,035
1990	130	260	190	150	0	210	120	1,060
2000	130	250	200	150	0	210	150	1,090
2010	130	225	200	140	0	210	150	1,055
2020	120	200	200	140	0	210	150	1,045
Pescadero-Butano Creeks Hydrographic Area - Butano Creek Watershed								
1962	93	5	60	23	0	161	0	342
1970	95	35	70	50	0	165	30	445
1980	115	125	100	80	0	165	60	645
1990	120	110	100	100	0	165	70	665
2000	120	100	100	100	0	165	70	655
2010	110	90	100	100	0	165	70	635
2020	100	80	90	100	0	165	60	595
Pescadero-Butano Creeks Hydrographic Area - Coastal Subarea								
1962	40	564	148	41	0	53	0	846
1970	40	830	160	70	0	50	200	1,350
1980	60	950	180	90	0	50	500	1,830
1990	60	900	190	100	0	50	450	1,750
2000	60	850	180	125	0	50	400	1,665
2010	50	800	180	120	0	50	400	1,600
2020	50	700	180	110	0	50	350	1,440
Pescadero-Butano Creeks Hydrographic Area - Gazos Creek Watershed								
1962	0	1	0	0	0	0	0	1
1970	0	10	10	5	0	0	10	35
1980	20	25	25	5	0	20	20	115
1990	15	25	25	5	0	20	20	110
2000	10	25	20	5	0	10	20	90
2010	10	20	20	5	0	10	20	85
2020	10	20	20	5	0	10	20	85
Pescadero-Butano Creeks Hydrographic Area - Total								
1962	248	570	353	136	0	407	12	1,726
1970	250	945	400	225	0	415	300	2,535
1980	320	1,375	485	300	0	445	700	3,625
1990	325	1,295	505	355	0	445	660	3,585
2000	320	1,225	500	380	0	435	640	3,500
2010	300	1,135	500	365	0	435	640	3,375
2020	280	1,025	490	355	0	435	580	3,165
Ano Nuevo Hydrographic Area								
1962	103	423	223	9	71	6	0	835
1970	100	540	250	35	75	10	300	1,310
1980	100	800	290	100	75	15	400	1,780
1990	75	800	300	120	80	15	375	1,765
2000	75	775	300	125	80	15	300	1,670
2010	75	750	250	125	80	1	300	1,595
2020	75	700	250	125	80	15	300	1,545
Investigation Area Total								
1962	762	1,962	1,071	658	78	875	33	5,439
1970	710	2,370	1,045	650	85	815	890	6,565
1980	700	2,875	1,020	650	90	810	1,395	7,540
1990	600	2,575	990	645	100	810	1,305	7,025
2000	555	2,300	980	575	100	775	1,150	6,435
2010	475	2,035	850	520	100	730	1,060	5,770
2020	425	1,815	830	480	100	720	955	5,325

Recreation Development

The coastal area of San Mateo County has historically served as a major recreation center for the San Francisco Bay Area. This recreation has generally been connected with marine activities such as ocean swimming, sunbathing, and rock fishing. Recreation in virgin redwood groves has also been important. These various recreation attractions have led to the development of extensive recreation-oriented facilities.

Present Recreation Development

The existing recreation developments in the coastal area are private, semiprivate, and public. Private developments consist of numerous summer cabins scattered throughout the upland portions of the investigation area. Concentrations of such developments are found in Redwood Terrace, La Honda, Loma Mar, and Butano Park, and at some locations along the coast. Many semiprivate developments have been constructed by church and scout groups, and other organizations. A few commercial recreation developments, financed with private capital, are available for public use on a fee basis. Public park and recreation facilities are provided by both county and state agencies.

Two parks are operated by San Mateo County in the coastal area: Memorial Park, located on Pescadero Creek, is intensively developed for both overnight and day-use activites, and McDonald Park, which is presently under development, is located on upper San Gregorio Creek. Development of McDonald Park will include riding and hiking trails and some camping facilities.

The State Division of Beaches and Parks operates several park facilities within the investigation area. The San Mateo Beaches State Park consists of numerous parcels of ocean frontage which have only limited development at the present time. Portola State Park, located in the upper portion of the Pescadero Creek Watershed, is developed and operated for the preservation and interpretation of the redwood ecology and has both camping and picnic units. Butano State Park is a redwood-oriented park located on Little Butano Creek and is currently under development. The initial development will include 90 camp units and attendant sanitary facilities utilities, access roads, and trails. Big Basin State Park, the first unit of the State Park System, is located immediately to the southeast of the investigation area.

To measure the extent of the land devoted to recreation purposes, lands presently used or reserved for recreation were delineated as a part of the 1962 land class survey. The results of this study are presented in Table 14.

TABLE 14

RECREATIONAL LAND USE IN THE COASTAL AREA OF SAN MATEO COUNTY

Hydrographic area Number	Name	Recreational land use (acres)
I	Montara-Moss Beach	17
II	Half Moon Bay	122
III	Middle Coastal	2
IV	San Gregorio Creek	576
V	Pomponio Creek	99
VI	Pescadero-Butano Creeks	2,964
VII	Ano Nuevo	23
	Investigation Area Total	3,803

Estimates of the extent of recreation activity in the coastal area are not readily available. The most recent estimates for San Mateo County are contained in the report, "California Public Outdoor Recreation Plan, Part II", which was published by the California Outdoor Recreation Plan Committee in November 1960. While the statistics in this report referred to all of San Mateo County, it appears reasonable to assume that the majority of this activity took place in the coastal area. The recreation activity statistics extracted from the report are presented in Table 15.

TABLE 15

RECREATION ACTIVITY IN SAN MATEO COUNTY IN 1958

Activity	Use (Activity days)
Picnicking	1,405,900
Camping	180,502
Riding and Hiking	102,012
Swimming	2,534,033
Boating	316,305
Fishing	341,500
Hunting	74,772
Total	4,955,024

Projected Recreation Development

Population increases in the San Francisco Bay Area will bring heavy pressures on the existing recreational facilities in the coastal area. A measure of the recreation activity which can be expected in the investigation area is contained in a report of the San Francisco District of the U. S. Army Corps of Engineers entitled, "Economic Base for Future Development of San Mateo Coastal Area". These estimates, presented in Table 16, show an ultimate recreation demand of 40 million activity days.

TABLE 16

PROJECTED RECREATION DEMAND IN THE COASTAL AREA OF SAN MATEO COUNTY (1,000 visitor days)

Activity	Year			Estimated Maximum
	1980	2000	2020	
Swimming	1,938	3,900	7,050	12,000
Fishing	912	2,080	3,640	6,200
Camping	228	1,040	1,880	3,200
Boating	57	130	212	320
Picnicking	2,166	4,446	8,507	14,920
Riding and Hiking	228	1,327	2,152	3,320
Hunting	171	77[a]	59[a]	40[a]
Totals	5,700	13,000	23,500	40,000

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[a] Hunting is assumed to be restricted because of urban encroachment and extended recreation use of the area.

The estimates shown above represent the total demand for recreation opportunities in the coastal area. To properly plan multiple-purpose reservoirs, the demand for reservoir associated recreation opportunities must be known. Estimates of this demand for day use and for camping are presented in Table 17.

TABLE 17

RESERVOIR RECREATION DEMAND IN THE COASTAL AREA OF SAN MATEO COUNTY
(Thousands of Visitor Days)

Year	Day-use demand	Camping demand	Total demand
1960(Base)	880	294	1,174
1970	1,567	522	2,098
1980	2,376	792	3,168
1990	3,295	1,098	4,393
2000	4,380	1,460	5,840
2010	5,574	1,858	7,432
2020	6,835	2,278	9,113

These estimated demands represent the probable upper limit for recreation use. The actual recreation use depends on the capacity of the facilities made available.

Fish and Game Resources

All watersheds in the coastal area of San Mateo County have fish and game resources which would be affected by the construction of water conservation facilities.

Streams in the coastal area generally support resident populations of trout, sculpin, and sticklebacks. When runoff conditions are favorable some streams support runs of steelhead trout and, to a limited extent, silver salmon. Pescadero Creek, which is rated as one of the 15 most productive steelhead streams in Northern California, supports a run estimated at 1,500 fish per year.

Deer are the only big game species found in the coastal area. The deer population is estimated to vary from 50 animals per square mile in the northern part of the investigation area to 75 in the southern. Native upland game species include valley quail, doves, band-tailed pigeons, and rabbits. French redlegged partridges have recently been introduced in the Pescadero Creek Watershed.

The effects of specific reservoirs on fish and game resources are included in the reservoir description sections in Chapter V.

Projected Land Use

The future land use patterns in the coastal area will be influenced by several factors. Among the more important are the increase in urban land use resulting from population increases and the development of new irrigated land to compensate for urban withdrawals and to satisfy increased demands for the crops grown in the coastal area.

Future urban land use patterns will be determined by population increases and by densities accompanying the increase. Present population densities in the various hydrographic areas vary from 1.3 to nearly 7 people per acre. Average densities under estimated maximum development are estimated to vary from 3.5 to over 6.5 people per acre. Future urban densities were projected in approximate proportion to population growth. This type of projection assumes that as the population of an area increases, not only is new land urbanized, but the use of lands already urbanized is intensified. Projections of urban land use are presented in Table 18.

Future agricultural crop patterns have previously been discussed. To compare future irrigated acreages with the projected urban land usage, the projected irrigated acreages are summarized in Table 19.

TABLE 18

PROJECTED URBAN LAND USE IN THE COASTAL AREA OF SAN MATEO COUNTY

	Urban land use (acres)					
Hydrographic area	1970	1980	1990	2000	2010	2020
Montara-Moss Beach	1,300	2,200	2,700	3,000	3,100	3,200
Half Moon Bay	1,470	4,000	5,500	6,400	7,200	7,700
Middle Coastal	125	500	1,200	2,500	3,500	4,500
San Gregorio Creek	250	500	900	1,200	1,300	1,600
Pomponio Creek	25	35	60	70	90	110
Pescadero-Butano Creeks	210	315	430	620	815	950
Ano Nuevo	45	110	210	310	410	500
Investigation Area Total	3,425	7,660	11,000	14,100	16,415	18,560

TABLE 19

PROJECTED IRRIGATED LAND USE IN THE COASTAL AREA OF SAN MATEO COUNTY

	Irrigated land use (acres)					
Hydrographic area	1970	1980	1990	2000	2010	2020
Montara-Moss Beach	445	180	50	0	0	0
Half Moon Bay	1,195	395	150	50	25	0
Middle Coastal	410	735	635	445	110	0
San Gregorio Creek	440	510	530	475	355	325
Pomponio Creek	230	345	345	325	330	310
Pescadero-Butano Creeks	2,535	3,625	3,585	3,500	3,375	3,165
Ano Nuevo	1,310	1,780	1,765	1,670	1,595	1,545
Investigation Area Total	6,565	7,570	7,060	6,465	5,790	5,345

CHAPTER III. WATER UTILIZATION AND REQUIREMENTS

Water supply is the most important water resources problem facing the coastal area of San Mateo County. Urban water supply problems presently exist in the town of Pescadero and can be expected to develop elsewhere in the area. There is also a deficiency in firm agricultural water supplies. The 1959-61 drought period caused a reduction in specialty crops acreages under cultivation.

The growth predicted in the preceding chapter is dependent on the provision of adequate water supplies, both urban and agricultural. Without provision for these needed supplies, there can be very little growth in the coastal area; the area will remain at its present level of development.

To formulate a comprehensive plan for the development of the necessary water supplies, a knowledge of the present supply and an estimate of amounts needed in the future are required. The following sections evaluate present water utilization and present projections of water requirements.

Urban Water Utilization and Requirements

The ultimate use of the lands in the coastal area of San Mateo County is expected to be urban and recreation. As the urban population grows, there will be a rapidly increasing demand for urban water supplies. Estimates of the demand are necessary to the formulation of a comprehensive plan. The evaluation of the demand was based on an analysis of past and present urban water use and on a projection of future urban use related to increasing per capita consumption and estimated population increases.

Past and Present Urban Water Utilization

Two water service organizations are presently serving the investigation area with urban water. These organizations are the Coastside County Water District, which serves the City of Half Moon Bay, and the Citizens Utilities Company, which serves the Montara-Moss Beach area. Table 20 shows estimates of the water marketed by these two organizations between 1955 and 1962. The estimates for the Coastside County Water District are the sum of the water produced at the district's wells on Pilarcitos Creek plus the water purchased from the City of San Francisco. The Citizens Utilities Company's utilization is based on water sales plus a 15 percent factor for system losses.

TABLE 20

HISTORIC URBAN WATER UTILIZATION
IN THE COASTAL AREA OF
SAN MATEO COUNTY
(Acre-feet/year)

Year	Service area		Total
	Citizens Utilities Company	Coastside County Water District	
1955	65	180	245
1956	70	195	265
1957	70	225	295
1958	75	250	325
1959	90	315	405
1960	95	390	485
1961	100	---[a]	---[a]
1962	---[a]	390	---[a]

a. Insufficient data

Estimates of the past and present per capita water use were developed for the service areas of the Coastside County Water District and the Citizens Utilities Company. These estimates were made on the basis of urban water use and estimated population in each service area. Population was estimated on the basis of persons per water service connection for April 1960 and the average number of services for each calendar year. For comparison, similar statistics were compiled for the City of Pacifica which lies immediately north of Montara and is served by the North Coast County Water District. The resulting per capita water use estimates are shown in Table 21.

TABLE 21

PER CAPITA WATER USE IN THE COASTAL AREA OF SAN MATEO COUNTY AND THE CITY OF PACIFICA

(Gallons per capita per day)

Year	Coastal Service Areas: Citizens Utilities Company	Coastal Service Areas: Coastside County Water District	Coastal Service Areas: Weighted average	City of Pacifica
1955	58	74	72	--
1956	58	72	71	--
1957	54	81	76	62
1958	60	84	80	66
1959	67	97	91	80
1960	64	111	101	71
1961	64	--	--	73
1962	--	101	--	--

Projected Urban Water Requirements

Future urban water requirements were based on projected per capita water requirements and on the projected population increases defined in Chapter II. The per capita water requirements are expected to increase from 105 gallons per day in 1970 in conformance with national and statewide trends of one gallon per day per year. It was assumed that the ultimate per capita water requirement would amount to 170 gallons per day. The resulting urban water requirements for each hydrographic area are presented in Table 22.

Projected Supplemental Urban Water Requirements

Future supplemental urban requirements are defined as the projected urban water requirements shown in Table 22, less

(1) estimates of existing urban or domestic supplies presently or potentially developable from sources other than surface waters, (2) an import of up to 2,500 acre-feet per year from the City of San Francisco to the Coastside County Water District through 1975, and (3) an import from the City of San Francisco to the area adjacent to Skyline Boulevard equivalent to the demands of unallocated population. Estimates of the supplemental urban water requirements of each hydrographic area are contained in Table 23.

TABLE 22

PRESENT AND PROJECTED URBAN WATER REQUIREMENTS IN THE COASTAL AREA OF SAN MATEO COUNTY

(acre-feet/year)

Hydrographic area		Year							Estimated
Number	Name	1962	1970	1980	1990	2000	2010	2020	Maximum
I	Montara-Moss Beach	100	350	1,290	1,890	2,430	2,940	3,190	3,820
II	Half Moon Bay	390	830	3,290	4,900	6,100	7,160	7,900	9,180
III	Middle Coastal	---	60	320	910	2,130	3,260	4,360	5,150
IV	San Gregorio Creek	110[a]	180	370	630	930	1,260	1,560	3,400
V	Pomponio Creek	---	20	20	30	50	70	80	1,530
VI	Pescadero-Butano Creeks	100[a]	130	190	320	470	640	790	11,150
VII	Ano Nuevo	10[a]	20	60	140	230	330	420	3,610
	Unallocated	---	60	130	420	760	1,140	1,500	7,650
	Investigation Area Total	710	1,650	5,670	9,240	13,100	16,800	19,800	45,500

[a] Estimated

TABLE 23

SUPPLEMENTAL URBAN WATER REQUIREMENTS IN THE COASTAL AREA OF SAN MATEO COUNTY

(acre-feet/year)

Hydrographic area		Year							Estimated
Number	Name	1962	1970	1980	1990	2000	2010	2020	Maximum
I	Montara-Moss Beach	---	150	940	1,490	2,030	2,540	2,790	3,420
II	Half Moon Bay	---	---	2,890	4,500	5,700	6,760	7,500	8,780
III	Middle Coastal	---	---	220	810	1,930	2,960	4,060	4,850
IV	San Gregorio Creek	---	---	170	430	730	1,060	1,260	3,000
V	Pomponio Creek	---	20	20	30	50	70	80	1,380
VI	Pescadero-Butano	---	30	90	220	370	540	690	9,500
VII	Ano Nuevo	---	20	60	140	230	330	420	3,510
	Unallocated	---	---	---	---	---	---	---	---
	Investigation Area Total	---	220	4,390	7,620	11,040	14,260	16,800	34,440

Agricultural Water Utilization and Requirements

The extent of the agricultural economy of the coastal area of San Mateo County in the past was described in Chapter II. Projections of the future size of this industry were also presented. Although records of the size of the agricultural economy are available, data on water utilization by this economy have not been maintained. To have a basis for projecting the agricultural water requirements of the investigation area, an applied agricultural water field measurement program was initiated.

Applied Agricultural Water Field Measurement Program

The applied agricultural water field measurement program began on May 1, 1963. The program consisted of the measurement of the actual applications of water upon six fields selected to represent several different soil types, land slopes, and elevations. The crops were Brussels sprouts, artichokes, and field flowers.

The data obtained from the program were analyzed, and representative water applications were obtained for the three crops. These representative amounts were used to compute water requirements for the investigation area. The amounts used were 1.2, 1.7, and 2.5 acre-feet per acre per season for Brussels sprouts, artichokes, and field flowers, respectively.

Present Agricultural Water Utilization

The land use survey showed the present crop pattern in the investigation area. The preceeding applied water use data, together with applied water factors of 0.75, 3.0, and 2.0 acre-feet per acre per season for miscellaneous truck crops, strawberries, and irrigated pasture, respectively, were used to compute the water used for the present crop pattern. The 1962 agricultural water requirement was estimated at 8,050 acre-feet. The distribution of this amount by hydrographic area is shown in Table 24.

Projected Agricultural Water Requirements

The amount of future agricultural water required depends on the state of the agricultural economy. Projections of future crop patterns were presented in Chapter II. These projections and the applied water use data were used as a basis for estimating future agricultural water requirements. The estimates are presented in Table 24.

TABLE 24

PRESENT AND PROJECTED AGRICULTURAL WATER REQUIREMENTS IN THE COASTAL AREA OF SAN MATEO COUNTY
(acre-feet/year)

Hydrographic area	Year						
	1962	1970	1980	1990	2000	2010	2020
I	850	620	300	120	0	0	0
II	2,440	1,720	650	310	120	60	0
III	370	400	750	630	450	120	0
IV	540	640	740	750	680	520	490
V	270	370	510	500	460	450	440
VI	2,510	3,240	4,200	4,270	4,220	4,040	3,850
VII	1,070	1,340	1,850	1,870	1,860	1,790	1,730
Investigation Area Total	8,050	8,330	9,000	8,450	7,790	6,980	6,510

Supplemental Agricultural Water Requirements

Supplemental agricultural water requirements are the difference between the total agricultural water requirements and the existing firm agricultural water supplies. Existing firm agricultural water supplies are the estimated average irrigation season stream flow during the 1959, 1960, and 1961 irrigation seasons plus the yield of surface water reservoirs and the yield from ground water basins. Estimates of future supplemental requirements are based on the assumption that the existing supplies will not be augmented or depleted. Estimates of present and projected supplemental agricultural water requirements are given in Table 25.

TABLE 25

PRESENT AND PROJECTED SUPPLEMENTAL AGRICULTURAL WATER REQUIREMENTS IN THE COASTAL AREA OF SAN MATEO COUNTY

(acre-feet/year)

Hydrographic area	Year						
	1962	1970	1980	1990	2000	2010	2020
V	--	100	240	230	190	180	170
VI	110	840	1,800	1,870	1,820	1,640	1,450
VII	530	800	1,310	1,330	1,320	1,250	1,190
Investigation Area Total	1,060[a]	1,740	3,350	3,430	3,330	3,070	2,810

[a] Includes a 1962 supplemental requirement of 420 acre-feet for Hydrographic Area II.

This table indicates that supplemental agricultural water supplies will be required only in the southern portion of the investigation area. In the northern portion of the area, urbanization will displace agriculture before new water supplies are needed.

Summary of Water Requirements

The total and supplemental water requirements of the coastal area of San Mateo County were determined to be the sum of the respective urban and agricultural requirements. Under ultimate conditions of development, urbanization is expected to displace agriculture. Estimates of total and supplemental water requirements are presented in Tables 26 and 27, respectively.

TABLE 26

TOTAL WATER REQUIREMENTS IN THE COASTAL AREA OF SAN MATEO COUNTY
(acre-feet/year)

Hydrographic area	Year							Estimated Maximum
	1962	1970	1980	1990	2000	2010	2020	
I	950	970	1,590	2,010	2,430	2,940	3,190	3,820
II	2,830	2,550	3,940	5,210	6,220	7,220	7,900	9,180
III	370	460	1,070	1,540	2,580	3,380	4,360	5,150
IV	650	820	1,110	1,380	1,610	1,780	2,050	3,400
V	270	390	530	530	510	520	520	1,530
VI	2,610	3,370	4,390	4,590	4,690	4,680	4,640	11,150
VII	1,080	1,360	1,910	2,010	2,090	2,120	2,150	3,610
Unallocated[a]	--	60	130	420	760	1,140	1,500	7,650
Investigation Area Total	8,760	9,980	14,670	17,690	20,890	23,780	26,310	45,490

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a. Unallocated water requirements will occur in areas not covered by the land class survey, generally adjacent to Skyline Boulevard.

TABLE 27

SUPPLEMENTAL WATER REQUIREMENTS IN THE COASTAL AREA OF SAN MATEO COUNTY
(acre-feet/year)

Hydrographic area	Year							Estimated Maximum
	1962	1970	1980	1990	2000	2010	2020	
I	--	150	940	1,490	2,030	2,540	2,790	3,420
II	420	--	2,890	4,500	5,700	6,760	7,500	8,780
III	--	--	220	810	1,930	2,960	4,060	4,850
IV	--	--	170	430	730	1,060	1,260	3,000
V	--	120	260	260	240	250	250	1,380
VI	110	870	1,890	2,090	2,190	2,180	2,140	9,500
VII	530	820	1,370	1,470	1,550	1,580	1,610	3,510
Unallocated[a]	--	--	--	--	--	--	--	--
Investigation Area Total	1,060	1,960	7,740	11,050	14,370	17,330	19,610	34,440

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a. Unallocated water requirements will occur in areas not covered by land class survey, generally adjacent to Skyline Boulevard.

CHAPTER IV. WATER SUPPLY

The water supply for the coastal area of San Mateo County is derived from precipitation on the area and importation from the City of San Francisco water supply. The precipitation generally occurs between October and May and is caused by eastwardly movement of Pacific Ocean storms across Northern California. Both surface and ground water supplies are generated by this precipitation.

Precipitation

Seasonal precipitation in the coastal area ranges from about 20 inches on the coast to over 50 inches at the higher elevations of the Santa Cruz Mountains. The steep precipitation gradient is due to orographic lifting caused by the Santa Cruz Mountains.

Since this precipitation is the source of developable water supplies in the investigation area, a rigorous analysis of its volume and areal extent was considered necessary as a basis for evaluating the yields of possible conservation projects. An isohyetal map was selected as the tool for this analysis.

A review of the precipitation stations within or adjacent to the coastal area revealed the existence of 12 stations with a long period of record. These stations were selected as the "base" for the isohyetal map. Table 28 lists the base stations, present elevation and period of record for the stations, and shows the mean precipitation for the selected base period of 1910-11 to 1959-60. The mean precipitation values have been adjusted to allow for changes in station location.

TABLE 28

PRECIPITATION BASE STATIONS FOR ISOHYETAL MAP OF THE COASTAL AREA OF SAN MATEO COUNTY

Station	Present elevation	Period of record	Adjusted mean precipitation for 1910-11 to 1959-60 base period
San Francisco	110 ft.	1849 to date	20.24 in. per year
Los Gatos	428 "	1885-86 to date	28.94 "
Santa Cruz	125 "	1873-74 to date	29.38 "
Santa Clara	88 "	1881-82 to date	13.67 "
Pilarcitos	695 "	1864-65 to date	41.46 "
San Andreas	377 "	1868-69 to date	30.81 "
Upper Crystal Springs	300 "	1875-76 to date	25.94 "
Lower Crystal Springs	300 "	1891-92 to date	25.00 "
Crystal Springs Cottage	300 "	1894-95 to date	22.36 "
Davenport	50 "	1910-11 to date	26.52 "
Palo Alto	23 "	1910-11 to date	15.31 "
San Mateo	30 "	1874-75 to 1920-21 1934-35 to date	19.40 "

An index of precipitation as a function of mean annual precipitation has been computed for the base period from the records of the 12 base stations. This index was used in a double-mass curve analysis of rainfall stations in and adjacent to the investigation area which have periods of record shorter than the base period. The records of over 50 stations were adjusted to the base period. These stations were used to prepare the isohyetal map for the investigation area, which is shown on Plate 3, "Isohyetal Map".

The isohyetal map was used to determine the mean annual precipitation on the individual hydrographic areas and the entire investigation area. These values are presented in Table 29.

TABLE 29

MEAN ANNUAL PRECIPITATION ON HYDROGRAPHIC AREAS
IN THE COASTAL AREA OF SAN MATEO COUNTY

Hydrographic area	Mean annual precipitation in inches
I	28
II-A	32
II-B	35
II-C	25
III	32
IV	30
V	25
VI-A	37
VI-B	32
VI-C	24
VI-D	32
VII	28
Investigation Area	32

Surface Water

The majority of surface water runoff in the coastal area occurs during short periods of time which coincide with or immediately follow periods of high rainfall. There is, however, a sustained base flow during periods of negligible rainfall.

Surface Water Measurements

Three surface water recording stations are presently in operation in the coastal area of San Mateo County. These recorders are located on Pescadero Creek, Purisima Creek, and Butano Creek. They were established in 1951, 1959, and 1962, respectively, and have been in continuous operation.

There are also a number of stations with relatively longer periods of record in watersheds adjacent to or near the coastal area. These stations are described in Table 30.

Historical Flows

The Pescadero Creek gaging station was selected as the base station for use in evaluating surface runoff because its period of record was the longest of the stations within the investigation boundaries. Historical annual flows have been developed for Pescadero Creek at the gaging station for the period 1899-1900 to 1962-63.

The development of these historical flows was accomplished by a correlation analysis of Pescadero Creek flows with flows of other surface water gaging stations and with precipitation stations. As a result of this analysis, the record for the Pescadero Creek gaging station was extended by the use of two correlations. The first of these was a correlation with the surface water station on San Lorenzo River at Big Trees. This correlation allowed the Pescadero Creek record to be extended to cover the period 1936-37 through 1950-51. The other correlation was with Los Gatos

SURFACE WATER RECORDS OF STATIONS WITHIN OR NEAR THE COASTAL AREA OF SAN MATEO COUNTY

Gaging Station	Drainage area (sq.miles)	Period of record	Source of record
Pescadero Creek near Pescadero	45.9	1951 to date	USGS
Purisima Creek near Half Moon Bay	4.83	1959 to date	USGS
Butano Creek near Pescadero	17.9	1962 to date	DWR
San Lorenzo River at Big Trees	111.0	1936 to date	USGS
Arroyo Seco near Soledad	244.0	1901 to date	USGS
Uvas Creek near Gilroy	71.2	1959 to date	USGS
Uvas Creek Reservoir	30.2	1959 to date	South Santa Clara Valley I.D.
Uvas Creek near Morgan Hill	30.2	1932-1956	USGS
Stevens Creek near Cupertino	18.0	1940-1959	USGS
San Gregorio Creek	20.2	1915-1917	Spring Valley W.C.
San Francisquito Creek at Stanford	37.7	1930-1941 1950 to date	USGS
Pescadero Creek near Camp Howard	18.1	1899-1904 and 1915-1916	Spring Valley W.C.
Pilarcitos Lake, San Andreas Lake, and Crystal Springs Lake		1867-1912 1912 to date	Spring Valley W.C. San Francisco W.D.

precipitation station. This correlation extended the record from 1935-36 back to 1899-1900. The estimates of historical annual flow resulting from these correlations, as well as the flows during the period of record, are presented in Table 31.

TABLE 31

HISTORICAL RUNOFF AT THE PESCADERO CREEK STREAM GAGING STATION (acre-feet)

Water year	Runoff	Water year	Runoff	Water year	Runoff
1899-1900	19,400	1921-22	32,300	1943-44	12,200
01	66,000	23	28,500	45	26,700
02	40,100	24	1,000	46	17,700
03	30,000	25	24,800	47	6,400
04	49,300	26	42,500	48	7,100
05	32,500	27	44,000	49	16,700
06	47,500	28	20,700	1949-50	14,700
07	58,700	29	7,400	51	43,700
08	11,200	1929-30	21,300	52	66,920
09	65,000	31	3,000	53	31,900
1909-10	14,800	32	33,000	54	16,520
11	81,000	33	7,000	55	15,660
12	9,500	34	18,200	56	66,970
13	3,300	35	29,800	57	13,090
14	81,600	36	11,300	58	74,790
15	43,500	37	27,200	59	11,980
16	49,000	38	63,500	1959-60	7,410
17	24,300	39	4,800	61	4,000
18	10,000	1939-40	59,400	62	16,800
19	23,200	41	94,200	63	47,990
1919-20	8,300	42	53,700		
21	36,100	43	38,800		

The average annual runoff for the period 1899-1900 to 1962-1963 is 31,100 acre-feet. The average annual runoff for the actual recorded period, 1951-1952 to 1962-1963 is 31,200 acre-feet The average monthly distribution of the average annual runoff for the period of record is shown in Table 32.

TABLE 32

AVERAGE MONTHLY DISTRIBUTION OF THE AVERAGE ANNUAL RUNOFF AT THE PESCADERO CREEK STREAM GAGING STATION DURING THE PERIOD OF RECORD (1951-52 to 1962-63)

Month	Percent of annual runoff	Monthly runoff in acre-feet
October	1.1	340
November	2.4	750
December	13.1	4,090
January	19.2	5,990
February	25.3	7,890
March	18.6	5,800
April	9.7	3,020
May	5.6	1,750
June	2.2	690
July	1.3	410
August	0.9	280
September	0.6	190
Average Annual Runoff	100.0	31,200

The historical flows developed for the Pescadero Creek gaging station can be used, in conjunction with the isohyetal map, to estimate the runoff at any particular damsite or for the entire investigation area by the area-precipitation method. Using this method, the average annual runoff from the coastal area is estimated to be 142,000 acre-feet. To check the results of the use of this method, the area-precipitation factor was computed for the Purisima Creek gaging station site. The factor obtained was 0.100, i.e., the flow at the Purisima Creek station is 10 percent of the flow at the Pescadero Creek station. For the 5 years of overlapping record, the average annual flow in Purisima Creek was 9.2 percent of the average annual flow in Pescadero Creek. While the comparison is based on a very short period of record, it is considered indicative of reliable results from the use of the area-precipitation method for estimating runoff at locations within the investigation area.

Existing Developments

Individual farmers have been developing small surface water storage reservoirs for irrigation and stock watering purposes for many years. Over 140 of these reservoirs are in operation in the coastal area. Eight of these reservoirs are formed by dams large enough to be subject to the provisions of Division 3 of the California Water Code. Dams subject to these provisions are under the supervision of the Department. These reservoirs, listed in Table 33, have an estimated firm yield of slightly over 1,800 acre-feet per year. The estimated firm yield of the reservoirs not under departmental supervision is over 600 acre-feet per year.

TABLE 33

DAMS IN THE COASTAL AREA OF SAN MATEO COUNTY
UNDER SUPERVISION OF THE
DEPARTMENT OF WATER RESOURCES

Dam	Watershed	Capacity (acre-feet)	Drainage area (sq.miles)	Estimated firm yield (acre-feet/
Johnston	Arroyo de Leon	30	7.6	30
Pomponio Ranch	Pomponio Creek	256	0.6	150
Lake Lucerne	Arroyo de Los Frijoles	455	4.7	1,250
Bean Hollow No. 2	Arroyo de Los Frijoles	900	1.4	a
Bean Hollow No. 3	Arroyo de Los Frijoles	461	1.2	a
Green Oaks No. 1	Green Oaks Creek	287	1.0	190
Lake Elizabeth	Green Oaks Creek	113	0.83	100
Coastways	Ano Nuevo Creek	100	0.12	90

a. Included in yield of Lake Lucerne.

Imported Supplies

Surface water supplies for urban utilization are imported into the investigation area by two agencies. The Coastside County Water District has been importing about 200 acre-feet per year for use in its service area around Half Moon Bay. The Skyline County Water District, which serves the area along Skyline Boulevard from Kings Mountain to Sky Londa, presently imports only a few acre-feet per year.

Surface Water Quality

An important aspect of a water resources investigation is the study of the quality of the waters being considered for development. To evaluate the waters of the coastal area, a sampling program was initiated. The objectives of this measurement program were to gather sufficient data to form a basis for comparison of water quality between the streams studied and to evaluate the probable quality of water impounded by dams.

Monthly samples for laboratory analysis were collected from Denniston, Purisima, San Gregorio, Pescadero, Butano, Gazos, and Whitehouse Creeks during the period September 1963 through May 1964. Additional monthly samples for field analysis were taken from Denniston, Purisima, and Pescadero Creeks about two weeks after the laboratory samples were collected. An electrical conductivity recorder was installed on Pescadero Creek to obtain continuous water quality measurements

The samples taken were collected at periods of both high and low flows during the year. The collection period did, however, fall in a relatively dry year and no large flood flows occurred. Detailed analyses of the samples collected are in the files of the Department. The range and arithmetic average for certain mineral constituents in the samples collected are presented in Table 34.

TABLE 34

MINERAL QUALITY OF SURFACE WATERS IN THE COASTAL AREA OF SAN MATEO COUNTY
(September 1963 - May 1964)

Creek	Constituents							
	Specific conductance (micromhos @ 25°c)		Boron (ppm)		Total dissolved solids (ppm)		Total Hardness (ppm)	
	Range	Average	Range	Average	Range	Average	Range	Average
Denniston	257 - 300	272	0.0-0.2	0.03	131-170	154	72 - 90	80
Purisima	619 - 695	668	0.07-0.1	0.09	372-445	410	267 -310	295
San Gregorio	748 - 1,010	943	0.03-0.5	0.4	465-636	591	253 -360	332
Pescadero	450 - 774	632	0.2 -0.6	0.4	310-476	410	177 -266	232
Butano	319 - 539	427	0.1-0.4	0.2	185-304	246	99 -160	132
Gazos	331 - 375	355	0.09-0.2	0.12	179-223	210	97 -111	104
Whitehouse	390 - 636	499	0.1-0.3	0.2	233-357	294	101 -176	132

As previously stated, the data in Table 34 are the arithmetic average of monthly or semimonthly samples. Such a sampling schedule does not necessarily show the best or the worst water quality in a given stream. Continuous water quality measurements are necessary to evaluate all rates of flow. An electrical conductivity recorder was installed on Pescadero Creek because it is a major watershed in the coastal area and because continuous flow measurements are available from the USGS stream gaging station.

For the period November 1963 through April 1964, the weighted average of specific conductance in Pescadero Creek was 428 micromhos. During the same period, the arithmetic average of the monthly samples was 645 micromhos. It can be assumed that the weighted averages of quality in the other six streams measured would also be better than the arithmetic averages.

Another consideration effecting the quality of surface waters in the coastal area is rainfall. This measurement program was conducted during a year of less than normal rainfall and runoff. It is reasonable to assume that the quality of water in all seven streams studied would be considerably better during years of normal and above normal rainfall and runoff.

As a result of the water quality sampling program, it was concluded that the waters of the streams studied are generally satisfactory for domestic, agricultural, and most industrial uses. Hardness of the waters in Purisima, San Gregorio and Pescadero Creeks is such that softening might be desirable for domestic and some industrial uses.

Ground Water

Ground water in the coastal area is derived from precipitation and surface runoff which percolates into the marine terraces and alluvial valleys. Development of ground water as an important water supply source is primarily confined to wells in the marine terrace around Half Moon Bay and aquifers adjacent to stream channels north of Half Moon Bay. South of the City of Half Moon Bay, ground water development is limited to small domestic wells and irrigation wells of minor importance.

Occurrence and Movement of Ground Water

The water-bearing aquifers in the coastal area were formed in the Quaternary age. They include Pleistocene marine and stream terrace deposits as well as Recent alluvium deposited by the streams of the area. The remaining area, principally mountainous, is underlain by rocks considered to be essentially nonwater-bearing.

Nine ground water basins have been defined within the area. They are located in the extreme western part of the area; and parts of all of these basins are probably in hydraulic continuity with the Pacific Ocean. The names and identification numbers of the basins are presented in Table 35.

TABLE 35

GROUND WATER BASINS IN THE COASTAL AREA OF SAN MATEO COUNTY

Name	State ground water basin number
Montara Terrace	2-21.00
Half Moon Bay Terrace	2-22.00
Tunitas Creek Group	2-23.00
San Gregorio Creek Group	2-24.00
Pomponio Creek Group	2-25.00
Pescadero-Butano Creeks	2-26.00
Pescadero Creek	2-26.01
Butano Creek	2-26.02
Pescadero-Franklin Point Terrace Group	2-28.00 and 3-21.00
Ano Nuevo Terrace	3-21.00
Los Frijoles	3-22.00

There are limited data regarding the occurrence and movement of ground water in the basins of the coastal area of San Mateo County. The water-bearing materials underlying these basins are generally medium to fine grained and consist of sands and silts with some interspersed pebbles and gravels. They produce only moderate quantities of water to wells. Wells in the Half Moon Bay Terrace generally produce water from depths o up to 80 feet, while wells in the other basins are generally less than 50 feet deep. Wells, in most cases, do not penetrate to bedrock; as a result, the thickness of water-bearing deposits in many of the ground water basins is unknown. It is possible that some of the valleys are "drowned valleys" and that alluvial deposits in them could be over 100 feet in thickness.

Movement of ground water in the basins is, in general, toward the stream valleys and, in the coastal terraces, toward the area to the west. Data are insufficient to indicate whether barriers to the lateral movement of ground water occur in any of the basins. These barriers may exist, however, as faulting in the area is extensive.

The bases of the marine coastal terrace deposits in all basins except the northern portion of Half Moon Bay Terrace are probably above sea level. As a result, the terrace deposits will not be subject to intrusion of sea water. The alluvial valleys in all of the basins, however, are exposed to, and in hydraulic continuity with, the Pacific Ocean. As a result, they may be intruded by saline water if water levels are drawn below sea level and a landward gradient produced. Data presented in the Department's unpublished Appendix A of Bulletin No. 63, "Sea Water Intrusion in California", 1960, indicate that degraded, or poor quality, ground water occurs in the Half Moon Bay Terrace and the San Gregorio Creek basins. This water, however, may naturally be of poor quality and not be caused by sea water intrusion.

Ground Water Utilization

Semiannual measurements of ground water levels in selected wells in the investigation area have been made for several years. A review of the records of these measurements showed the expected positive correlation between ground water levels and seasonal precipitation. Many wells were at their highest level during the spring of 1958, a year with precipitation of more than 150 percent of normal. Lower ground water levels occurred in the falls of 1959, 1960, and 1961, years of less than normal rainfall.

Estimates of ground water storage and safe yield were not made as a part of the investigation. The magnitude of present ground water utilization has, however, been determined. Records of water sales by the Coastside County Water District and by the Citizens Utilities Water Company are available. From these records, it has been possible to develop estimates of ground water utilization for commercial and domestic uses in the service areas of these organizations. These estimates are contained in Table 36.

TABLE 36

HISTORICAL GROUND WATER UTILIZATION FOR URBAN PURPOSES IN THE MONTARA-MOSS BEACH AND HALF MOON BAY HYDROGRAPHIC AREAS

Year	Ground water utilization (acre-feet/year)
1952	50
1953	50
1954	60
1955	65
1956	140
1957	225
1958	275
1959	235
1960	270
1961	240

The ground water utilized by the Coastside County Water District is derived from wells in the upper part of Pilarcitos Creek. These wells extend into the streambed gravels of the creek. The water thus derived is probably subsurface flow of Pilarcitos Creek.

Ground water utilized by the Citizens Utilities Company is derived from wells immediately north of the Half Moon Bay Airport. These wells are relatively deep and have a long history of reliable production.

Practically all domestic uses of water outside of the service areas of the Coastside County Water District and the Citizens Utilities Company are met by small domestic wells. The present utilization of water from these wells has been estimated to be 200 acre-feet per year.

Utilization of ground water for irrigation purposes is primarily confined to the Half Moon Bay and Montara-Moss Beach hydrographic areas. It has been estimated that during the 1962 irrigation season, about 600 acre-feet of ground water were utilized in these areas for irrigation purposes.

Although estimates of ground water storage and safe yield were not made as a part of the investigation, the possibility of meeting part of the ultimate supplemental water requirements with ground water was considered.

Data on approximately 150 existing wells reported on in Appendix A of Bulletin No. 63 were analyzed. The average yield factor for these wells is about 2.35 gallons per minute per foot of drawdown per 100 feet of well depth. Production from these wells averaged only 35 gallons per minute. From this analysis, it was concluded that the yields of wells in the coastal area are too low to allow economical development.

Flood Flows

Flooding is a recurring problem in the watersheds of the coastal area of San Mateo County. Overbank flows have caused damage to homes and businesses, utilities and roads, and agricultural lands. Although flood damage has been mainly confined to utilities, roads and agricultural lands, anticipated future growth will make urban developments subject to damage from floods.

Since its installation in the fall of 1951, the gaging station on Pescadero Creek has recorded 6 floods of major importance. These floods occurred in March 1952, December 1952, December 1955, April 1958, October 1962, and January 1963. The largest and most damaging of these floods was that of December 1955

The flood of December 1955 had a peak discharge of over 9,400 cubic feet per second (cfs). This flood had a secondary peak of 7,000 cubic feet per second. The next largest flood of record occurred in April of 1958 and had a peak discharge of over 7,600 cubic feet per second.

The U. S. Army Corps of Engineers made a flood damage survey in the coastal area after the flood of 1955. The information obtained in these surveys was used to make estimates of flood damage. The U. S. Corps of Engineers estimated the flood damage on Pescadero Creek to be $335,000. The total damage in the Pescadero, San Gregorio, Tunitas, and Pilarcitos Creek Watersheds amounted to $485,000.

There are two types of physical works which could, either singly or in combination, provide adequate flood protection. These are flood control reservations in reservoirs and channel improvements in reaches of the flood plain subject to damage.

Flood control has not been included as a project purpose in the reservoirs evaluated during this investigation. There are two factors which tend to reduce the effectiveness of flood control reservations in the reservoirs under study. The first of these is the high unit cost of storage in the reservoirs being evaluated. The second detriment is the distance between the reservoirs under study and the area to be protected. Flood control reservations in reservoirs are most effective when located immediately upstream from the area protected. In the coastal area, the distance between the reservoirs and the protected areas is relatively great. The inclusion of flood control reservations in reservoirs constructed in the coastal area requires detailed study and analysis.

Channel improvements in the reaches of the flood plain subject to damage are the second type of physical works which could provide adequate flood protection. Evaluation of this method of flood protection was not within the scope of this investigation. The "Pescadero Creek Report Prepared for the County of San Mateo", by George S. Nolte, Consulting Civil Engineers, Inc., indicates that channel improvements are the most economical means of protecting the flood plain of the watershed. This method of protection would have to be compared to reservoir storage to provide the most economical solution to the flood problem in any watershed of the coastal area.

Some flood protection would be realized from the routing effect of the reservoirs. Although the peak flows are large, the volume of the floods are relatively low because of the "flash flood" characteristics of the watersheds. Studies of the effect of reservoir routing were made at the Worley site on Pescadero Creek and the results indicated that the peak flow of the site would be reduced by approximately 40 percent. The downstream effects of the reduction of peak flows on flood damage were not determined.

At the present time, the U. S. Army Corps of Engineers has authorization to prepare survey reports on the San Gregorio Creek and Pescadero Creek Watersheds. The California division of Soil Conservation has authority to prepare a watershed work plan for the southern part of the Department's investigation area. Completion of these studies should lead to a solution to the major flood problems in the coastal area of San Mateo County.

Evaporation

If reservoirs are developed in the coastal area of San Mateo County, losses due to evaporation will have an effect on the yields of the reservoirs. Monthly gross evaporation was estimated for the investigation area by use of the Blaney-Criddle equation which is:

$e_{pan} = k\ pt/100$, where

k = a constant which varies for the month

p = percent daylight hours

t = mean monthly temperature in °F

e_{pan} = pan evaporation in inches/month

Solution of the equation for the coastal area was based on constants developed for the evaporation station at Newark, percent daylight hours at Watsonville, and temperature at the Half Moon Bay weather station. Monthly pan evaporation was adjusted to monthly lake surface evaporation by the use of coefficients defined in Table 6, Appendix B, Bulletin No. 73, "Evaporation From Water Surfaces in California", which was published by the Department in October 1959. Average monthly gross evaporation from water surfaces in the investigation area is presented in Table 37.

TABLE 37

AVERAGE MONTHLY GROSS EVAPORATION FROM WATER SURFACES IN THE COASTAL AREA OF SAN MATEO COUNTY
(FEET)

Month	Gross Evaporation
January	0.07
February	0.11
March	0.20
April	0.30
May	0.36
June	0.51
July	0.50
August	0.48
September	0.38
October	0.25
November	0.14
December	0.07
Total	3.37

Sedimentation

Another factor which will have an effect on the yield of any reservoir developed in the coastal area is sedimentation. Unless sufficient space is allocated to this purpose, the accummulation of sediments in a reservoir can reduce the available storage to a point where economic utilization is impaired.

There is very little data available on the sedimentation yields to be expected from watersheds in the coastal areas of Northern California. This is partially due to the high cost of making the necessary surveys. To have a basis for computing sedimentation reservations for the reservoirs being evaluated by the investigation staff, the available literature was reviewed in an attempt to find records of actual surveys which could be applied to the coastal area of San Mateo County.

This review revealed three measurement programs. One of these, conducted by the Department of Irrigation at the University of California at Davis, was for a small reservoir in the investigation area. This reservoir is located on the headwaters of Pomponio Creek and has a drainage area of slightly more than one-half square mile. The study revealed that for a six-year period, 1952 to 1958, the sediment yield of the watershed was 2.4 acre-feet per square mile per year. Since the period covered by the survey included the two largest floods of record, December 1955 and April 1958, this rate of sedimentation is considered to be greater than the average rate which would occur during the economic life of a project in the area.

The report on the above study also contained references to two other measurement programs. The first of these was made by the U. S. Corps of Engineers for Upper Crystal Springs Reservoir, which is located immediately adjacent to the investigation area. The U. S. Army Corps of

Engineers reported a sedimentation rate of 1.4 acre-feet per square mile per year. The other program cited was for the East Bay Municipal Utility District's Alameda County reservoirs. The rates here ranged from 1.6 to 1.7 acre-feet per square mile per year.

After consideration of the three measurement programs described above and a review of the sedimentation rates selected by the U. S. Army Corps of Engineers for reservoirs it has recently proposed in the San Francisco Bay Area, a design rate of 1.5 acre-feet per square mile per year was selected for use in this investigation.

CHAPTER V. EVALUATION OF POSSIBLE STORAGE, DIVERSION, AND CONVEYANCE UNITS

In Chapter III the total water requirements of the area were estimated to increase to 26,300 acre-feet by the year 2020 and to 45,400 acre-feet for conditions of maximum development. The annual yield of the Pescadero and Butano watersheds was estimated to be 40,000 acre-feet in "The California Water Plan." Since these two watersheds represent only a portion of the investigation area, it is apparent that the estimated maximum water requirement of the coastal area can be met by development of local water supplies.

This chapter contains an engineering and relative cost evaluation of the ability of potential water conservation facilities to meet the supplemental water requirements of 19,600 acre-feet in 2020 and 35,000 acre-feet for ultimate conditions. The projected demands for fresh water recreation, the needs for flood control and fisheries, and the requirements for diversion and conveyance units that are appurtenant to storage facilities are also considered.

The first step in planning for the needed facilities was the definition of potential damsites. Some 43 dam and reservoir sites were defined in or near the area. The area contains 15 significant watersheds; many of which contained more than one potential damsite. The damsites defined are listed and located on Plate 4, "Location of Potential Damsites".

The initial evaluation of storage sites was a comparison of sites within the same watershed to determine which alternate was more economical. Fourteen dam and reservoir sites were deleted from further consideration as a result of the initial evaluation. The total estimated yield which the remaining reservoir sites would develop appeared to be far in excess of that required to satisfy the ultimate water requirements of the area. Therefore, more detailed geologic engineering and relative cost analyses of the remaining sites were undertaken. As a result of these studies it was concluded that 13 of the original 43 potential dam and reservoir sites should be considered in formulating alternative staged development plans for the area. To complete the information necessary to formulate the staged development plans, the costs of diversion to offstream storage sites and the costs of conveyance units from storage sites to the areas of use were also determined. To analyze the desirability of including recreation facilities in the staged plans, recreation plans and costs were prepared for selected reservoir sites. The details of the evaluation of possible storage, diversion, and conveyance units for water resources development are contained in the following sections of this chapter.

General Geologic Conditions

The investigation area is located in the northern part of the rugged Santa Cruz Mountains. Relatively flat marine terraces border the mountains on the west. These terraces are generally discontinuous; however, in the vicinity of Half Moon Bay there is a terrace approximately 12 miles in length. Streams draining the Santa Cruz Mountains generally flow westward. In the southern half of the area the western reaches of the streams are often deeply entrenched and flanked by high terraces. The stream valleys in the investigation area have significantly alluviated their valleys only within several miles of the coast.

The northern Santa Cruz Mountains are of moderately rugged relief. The uplands, which seem to be an old erosion surface which is dissected by steep, V-shaped canyons in the youthful stage of development, are underlain principally by marine sediments of Upper Cretaceous, Tertiary, and Quaternary ages. The sediments overlie a basement complex of igneous and metamorphic rocks. Landsliding is prevalent in this mountainous area. The various formations are shown on Plate 5, "Regional Geology".

Tertiary sediments, which are exposed in most of the area, are strongly affected by northwest trending folds and high angle reverse and normal faults. The intensity of folding and faulting seems to increase with age of the rocks; and strata older than Miocene are more strongly affected than younger deposits. The fault system is dominated by the major San Andreas fault and its distributaries. Other major faults in the area include the San Gregorio-Seal Cove, Pilarcitos, and Butano faults.

On the basis of plotted epicenters of record and close proximity to the active San Andreas fault, San Mateo County should be considered an area of high seismic activity at the present time. An outstanding earthquake is possible on the San Andreas fault zone, which is within 15 miles of any damsite in the coastal area of San Mateo County. The historical record indicates that major earthquakes occurred along this segment of the fault zone in 1838 and 1906. A tenuous estimate of earthquake periodicity suggests that the occurrence of such an earthquake during the next 50 years is possible.

Geologic data indicate that formations underlying proposed damsites in the coastal area of San Mateo County can be grouped into two general types with regard to foundation conditions, availability of construction materials, stability problems, tunneling conditions, etc. The first type includes the competent and consolidated Pigeon Point Formation of Cretaceous age and Butano Formation of Eocene age, as well as the quartz diorite exposed in the Montara Mountain area north of Half Moon Bay. The second type includes the Miocene Monterey and Pliocene Purisima Formations that appear to be structurally weak, are often severely broken and sheared, and are subject to landsliding.

The Monterey and Purisima Formations will pose some serious foundation problems for dam structures. They probably will require more expensive foundation treatment than the older and more competent rocks. Stripping and cutoff trench depths will be greater due to the weathered nature of these deposits, the prevalence of landslides, and the possibility of significant leakage. Substantial quantities of grout may be necessary in the fractured Monterey Formation while the fine-grained Purisima Formation may not be groutable. Extensive blanketing may be necessary to prevent abutment leakage and dam slopes may have to be flatter due to the general weak nature of the foundation rocks.

Thick sections of decomposed granitics and thick sections of slope wash may require extensive stripping depths in the Montara quartz diorite area, and excessive silting of reservoirs may occur.

Initial Reservoir Study

The developable safe **yield** of the streams in the coastal area is well in excess of the estimated maximum annual supplemental water requirement of 35,000 acre-feet. Therefore, initial studies of possible reservoir projects were directed toward reducing the number of reservoir sites to those which might produce the required firm yield at the lowest unit water cost. The initial reduction was made by comparison of the relative costs of dam and reservoir sites within the same watershed.

This comparison was made by developing area-capacity curves, dam embankment volumes and costs, and rights-of-way and relocation costs for each reservoir site. The area-capacity curves, were developed for each reservoir site from USGS 7-1/2 minute topographic maps. Embankment volumes for each dam were calculated at three heights, and embankment volume versus elevation curves were developed for each site. Wherever possible, dam heights were selected for reservoir volumes that would have a yield equal to about 600, 500, and 300 acre-feet per square mile of drainage area.

The dam embankments were designed using upstream and downstream slopes of 3:1 and a crest width of 25 to 30 feet. No consideration was given to the zoning of the dam cross section, nor was a stability analysis made.

Dam construction costs were determined using a unit cost of $1.35 per cubic yard of embankment volume. This cost was considered to be sufficient to include appurtenant structure such as the spillway and outlet works as well as the embankment. Rights-of-way costs were determined by estimating the number of buildings inundated and the reservoir acreage. The value of buildings was set at an arbitrary figure of $5,000 per building and the number of buildings inundated were counted directly from the map quadrangle. No attempt was made to differentiate between types of buildings. Unit costs ranging from $750 per acre to $2,000 per acre were used to obtain rights-of-way costs. These costs were based on discussions with local real estate agents and information available in the classified sections of local newspapers. Road relocation costs were developed by using costs similar to those estimated in "City-County Highway Plan for San Mateo County", George S. Nolte Civil Engineers, Inc., November 1962. Roads were placed into one of three categories and unit costs of either $100,000, $150,000, or $200,000 per mile, depending on terrain and road standards, were applied to their relocations.

Yields for all reservoir sites were based on a graphical study of gross yield versus reservoir capacity at the Pescadero Creek gaging station. This study was based on the water supply period 1919-20 to 1961-62. As a result of this study, it was found that the critical period for small reservoirs which develop less than 50 percent of the potential watershed yield of 600 acre-feet per square mile occurred over the period 1957-58 to 1961-62. The critical period for larger reservoirs occurred within the period 1941-42 to 1950-51. A curve of storage per unit area versus gross yield per unit area was plotted from the Pescadero Creek yield study. This curve was then applied to all reservoir sites regardless of watershed.

The assumption that yield studies of the Pescadero Creek watershed are applicable to all drainage areas of the coastal area was predicated upon data in the report, "Agriculture, Population Increase and Water Problems in San Mateo County", San Mateo County Farm Advisor, 1956. These data indicated that the average precipitation upon nearly all watersheds in the coastal area was at least 90 percent of the precipitation on the Pescadero Creek watershed. This assumption was proved correct by the isohyetal map discussed in Chapter IV.

As a result of the initial reservoir study, 14 damsites were deleted from further consideration. Deletion of 11 of these sites, Nos. 4, 14, 15, 17, 19, 20, 21, 24, 25, 31, and 32, was generally based on the conclusion that alternative sites within the same watershed would be more economically justified. The Leon site, No. 8, was deleted because it was found to have topographical limitations that make it suitable only as a diversion site for interbasin transfer of water. Loma Mar No. 1, site No. 28, was eliminated because it has geological disadvantages when compared to Loma Mar No. 2, site No. 29. Ano Nuevo, site No. 42, was found to be directly over the San Gregorio-Seal Cove Fault. Exploration by the landowner revealed extremely poor foundation conditions.

To further reduce the number of sites under study, more detailed geologic and alternative cost studies were made of the sites not eliminated in the initial study.

Geologic Evaluation of Selected Damsites

Surface geologic reconnaissance studies were made for 19 of the remaining damsites which appeared to offer the best opportunity for economical storage. Existing geologic maps and aerial photographs were used and field observations were made.

The coastal area of San Mateo County is seismically active and all of the proposed damsites are within 15 miles of the active Pilarcitos and San Andreas faults. Earthquakes resulting from movement along geologic zones of weakness could either directly damage proposed dams, spillways, or other structures or could trigger existing or potential landslides in structurally weak rocks which could cause damage directly to structures, or indirectly through the action of seiches developed in the reservoirs.

Geologically, foundation conditions for proposed damsites in the coastal area are relatively poor. Landsliding is prevalent; the area is seismically active; and sedimentary strata are severely folded and faulted. Some of the formations are relatively weak and incompetent; and others, although competent, are severely weathered. On the basis of geologic conditions, 11 of the 19 sites studied were considered to be good or relatively good sites, 3 were considered poor, or relatively poor sites, and the remaining 5 were considered to be so poor that they were either conditionally recommended or not recommended at all. The sites which were conditionally recommended or not recommended are situated upon the structurally weak Monterey and/or Purisima Formations. Two of the sites considered to be poor or relatively poor are also located upon these weak formations (the other is upon the competent Butano Sandstone). Only one of the good or relatively good damsites is situated upon the Purisima or Monterey Formations. All but two of the good, or relatively good sites, are upon the competent Pigeon Point Formation, Butano Formation, or the Montara Quartz Diorite. The remaining two relatively good sites are situated partly on competent Pigeon Point Formation and partly on the weak Purisima Formation. The reconnaissance reports for the individual sites evaluated are summarized in Appendix E, "Summary of Engineering Geologic Conditions for Selected Damsites".

Problems regarding construction materials also exist in Coastal San Mateo County. Impervious materials of sufficient quantities appear available at any site. However, impervious materials from decomposed quartz diorite at the Skyline and Denniston sites are probably low in density, perhaps highly compressible, and easily eroded. Sufficient quantities of naturally occurring pervious materials generally appear lacking at all sites. Crushed rock from the competent Butano and Pigeon Point Formations and the Montara Quartz Diorite will probably have to be used for coarser pervious materials.

Crushed and broken stone is now being produced from a quarry in the quartz diorites in the northern part of the investigation area. New quarries would have to be developed in the Butano Sandstone located in the drainage basins of Lobitos, Tunitas, and Pescadero Creeks and in the Pigeon Point Formation at the Gazos and Bean Hollow damsites.

Relative Cost Evaluation of Selected Damsites

Concurrently with the geologic evaluation, an evaluatio of the relative costs of the sites remaining after the initial reservoir study was undertaken. Capital costs of reservoirs were refined by developing a unit cost curve for earth dams and adjusting rights-of-way costs. Greater consideration was also given to the geology reconnaissance outlines as they became available, and for three sites use was made of topographical maps with larger scale fractions. The cost of conveying water to the areas of use was considered when comparing small reservoir in the northern part of the investigation area.

A unit cost curve for earth dams was developed by analyzing bid abstracts of dams recently constructed in California and estimates of dams studied in previous investigations. The results of this analysis were used to obtain unit construction costs of earth dam structures. The unit costs varied from $1.35 per cubic yard of dam embankment for structures with embankments in excess of 4,500,000 cubic yards to $2.25 per cubic yard for structures under 300,000 cubic yards.

Many of the reservoirs under investigation have considerable costs for rights-of-way. The San Mateo County Tax Assessor's office supplied reasonably accurate rights-of-way costs for the final cost reconnaissance of these reservoirs. These estimates were based on assessed valuation and, wherever possible, recent sales in the area. In several cases, reservoir areas were roughly divided into valley, gently sloping, and sloping land categories and a different unit cost was applied to each category.

Contingency factors of 25 percent for rights-of-way, 15 percent for field costs, and 15 percent for engineering costs were included in the estimates of capital costs.

Offstream Storage Sites

In addition to evaluating single purpose reservoirs which develop the yield of their own watersheds, two alternative plans for offstream storage of Pescadero Creek and Butano Creek waters were studied. The first of these consisted of storage in Butano Reservoir, site No. 33; the second of storage in Pigeon Point Reservoir, site No. 38, which is located within the Arroyo de los Frijoles and Gazos Creek watersheds.

Butano Reservoir would consist of a major structure just upstream from Pescadero Creek Road, a dike at a low point between the Butano Creek watershed and the Pescadero Creek watershed, and a diversion structure on Pescadero Creek about a mile upstream from the town of Pescadero. A 160-foot dam would develop a capacity of 67,800 acre-feet.

Pigeon Point Reservoir would consist of major structures at Bean Hollow, site No. 37, and at Gazos No. 1, site No. 39, plus a connecting channel between the watersheds, a diversion structure on Butano Creek, and a diversion structure on Pescadero Creek. With a 210-foot dam on Gazos Creek, and a 230-foot dam on Arroyo de los Frijoles, a capacity of 81,500 acre-feet would be developed.

The proximity of the San Andreas and Butano faults and the difference in the foundation conditions of the two sites indicate that the Butano Dam would be a less favorable site than the Pigeon Point Reservoir dams. Project staging could be more readily accomplished with the Pigeon Point Reservoir because it consists of several structures. The structures could be staged as dictated by the buildup of water requirements. The importance of this staging becomes increasingly evident when the demand for the area is considered, particularly with use of 4 percent interest rates. An additional advantage of the Pigeon Point Reservoir is that rights-of-way costs would not escalate as rapidly as with the Butano Reservoir.

On the basis of geologic advantages, favorable capital cost and potential staging advantages, it has been concluded that further studies of offstream storage should be directed toward the Pigeon Point Reservoir.

Results of Geologic and Relative Cost Evaluations

As a result of the geologic and relative cost evaluations, an additional 16 sites were deleted from further consideration. These sites and the more important reasons for deletion are summarized in Table 38.

TABLE 38

RESERVOIRS DELETED AS RESULT OF GEOLOGIC AND RELATIVE COST EVALUATIONS

Reservoir and site number	Reasons for deletion
Montara (1)	Small yield, costs probably higher than estimated due to map scale, does not economically compare with Denniston Reservoir (2).
Vasquez No. 1 (3)	Delivered cost of water not competitive with other reservoirs in the area.

TABLE 38 (Continued)

RESERVOIRS DELETED AS RESULT OF GEOLOGICAL AND RELATIVE COST EVALUATIONS

Reservoir and site number	Reasons for deletion
Skyline (5)	Delivered cost of water not competitive with other reservoirs in the area.
Barr (6)	Downstream site has higher yields at equivalent or lower costs.
Miramontes (7)	Delivered cost of water not competitive with other reservoirs in the area.
Purisima No. 3 (11)	Downstream sites have higher yields at lower costs.
Tunitas No. 1 (13)	Not competitive with San Gregorio No. 2 (16) or Purisima No. 1 (9).
San Gregorio No. 4 (18)	Not competitive with San Gregorio No. 2 (16).
Harrington (22)	Small yield; not competitive with San Gregorio No. 2 (16).
La Honda (23)	Not competitive with San Gregorio No. 2 (16).
Dearborn (27)	Not competitive with Loma Mar No. 2 (29) or Pescadero (26).
Butano (33)	Not competitive with Pigeon Point (38).
Juanita No. 1 (34)	Poor site geologically, barely competitive with Butano (33).
Juanita No. 3 (36)	Not competitive with site downstream.
Gazos No. 2 (40)	Not competitive with site downstream.
El Oso (43)	Not competitive with more northerly reservoirs.

As a result of the preceding studies, it was concluded that the staged development plan to meet the ultimate supplemental water requirements of the investigation area and the initial features of this plan should be selected from storage or diversion structures at the following damsites (site number is parenthesis):

1.	Denniston	(2)
2.	Purisima No. 1	(9)
3.	Purisima No. 2	(10)
4.	Lobitos	(12)
5.	San Gregorio No.2	(16)
6.	Pescadero	(26)
7.	Loma Mar No. 2	(29)
8.	Worley	(30)
9.	Juanita No. 2	(35)
10.	Bean Hollow	(37)
11.	Pigeon Point	(38)
12.	Gazos No. 1	(39)
13.	Whitehouse	(41)

Criteria for Analysis of Dam and Reservoir Sites Considered in Formulating the Staged Development Plans

A description of the general criteria used in the studies of the remaining 13 dam and reservoir sites is presented in the following paragraphs. Specific points are covered in the sections describing the individual units.

Mapping

Topographic mapping for damsites and reservoir areas was obtained from three sources. Photo-contour maps, with a scale of 1"=200' and a contour interval of 10 feet for the area along State Highway No. 1 between Moss Beach and Tunitas Creek and along Ralston Avenue between Half Moon Bay and Pilarcitos Creek, were supplied by the California Division of Highways. Photogrammetric maps with a scale of 1"=400' and a contour interval of 20 feet were prepared by the department for all damsites except Pescadero. The Denniston, Purisima, Bean Hollow, and Gazos No. 1 reservoir areas were also mapped at the same scale. Topographic mapping for the Pescadero damsite and the other reservoir areas was obtained by enlarging 7-1/2 minut USGS quadrangle maps to a scale of 1"=400'.

Embankment Section and Spillway

For purposes of cost estimates, a rolled earth-fill secti with a 30-foot crest width and slopes of 4:1 upstream* and 3:1 downstream was used for all storage dams except Denniston, Bean Hollow, and Gazos No. 1. More stable foundation conditions at these sites indicate that an upstream slope of 3-1/2:1 would be adequate. The section includes a 20-foot thick chimney drain and a 15-foot thick horizontal drain. Upstream slope protection is provided by riprap extending from the crest to 5 feet below minimum pool.

The quality, quantity, and location of construction mater was based on surface reconnaissance and stereo-photo interpretation. In addition, mechanical analyses were made of samples from the Denniston, Purisima No. 1, Purisima No. 2, Worley, and Gazos reservior areas. These tests confirmed the reconnaissance and outlined the extent of the borrow areas at the sites sampled. Ther appear to be adequate quantities of impervious material at all site. Sources of pervious material have previously been discussed.

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* Slope decreased from 3:1 to 4:1 as a result of geologic studies.

The spillways consist of an uncontrolled ogee type weir, a concrete lined chute, and a flip bucket terminal. They were sized to pass the probable maximum flood without damage to the dam and spillway. The outlet works consist of a cut and cover conduit with an emergency high pressure slide gate at the intake structure and a regulating valve and an energy dissipating valve at the downstream end. The conduit would be a 36-inch steel-lined reinforcement concrete pipe with cutoff collars at 20-foot intervals. The gates and valves would be hydraulically operated from a control house on the crest of the dam. The outlet works would be the primary means of diverting the stream during construction.

Rights-of-Way

The unit rights-of-way costs developed for the final reconnaissance cost study were considered adequate. Rights-of-way requirements include a control strip extending 100 to 200 feet horizontally from the maximum water surface. Road relocations were limited to a maximum grade of 7 percent. Unit costs sufficient to allow construction to modern standards were used.

Hydrology

Gross yield estimates were obtained from gross yield versus storage curves which were prepared for each reservoir by means of a graphic mass curve analysis. The mass curve, based on Pescadero Creek flows, was developed for the period 1901 to 1963. The critical period for a given storage was defined as the period which produced the minimum yield for the given storage.

Gross yields were tabulated for a range of storage from 5,000 to 100,000 acre-feet. The values obtained were made applicable to all watersheds by plotting them on the basis of units per square mile of drainage area.

Net yield estimates were obtained for selected reservoirs from mathematical operation studies. The capacities of the reservoirs studied were those considered most likely to be incorporated into a staged development plan. The operation studies allowed for demand, a sediment pool, evaporation losses, mandatory releases for downstream use, and releases for anadromous fish, when necessary. Estimates of mandatory releases were based on present irrigated acreage and unit use values obtained from the Applied Agricultural Water Field Measurement Program. It was assumed that riparian and appropriative water rights in the area were satisfied. Appropriative rights are summarized in Appendix A, "Applications to Appropriate Water in the Coastal Area of San Mateo County". The releases for anadromous fish are discussed below. Net yields for reservoirs and capacities not included in the mathematical operation studies were obtained by applying loss factors based on the ratio of net yield to gross yield for the capacities evaluated.

Recreation

To estimate the potential for recreation areas at the reservoirs being studied, the Recreation Contract Services Unit of the California Division of Beaches and Parks made a general evaluation of the reservoir areas. Factors considered in the general evaluation were attractiveness, developability, accessibility, location, and reservoir sizing. Based on these factors, the recreation potential was determined to be limited.

The major reason is the lack of balance between topography and vegetative cover; wooded areas are generally too steep and the areas flat enough for development lack tree cover. A large demand for recreation facilities is present because of the areal proximity to urban centers, but areas suitable for development at individual reservoirs will present access problems and reservoir sizing will, in some cases, limit the types of recreation. Development of some of the project units under study would adversely affect existing recreation facilities. The full report on this study, together with the report on the study described below, are presented in Appendix D, "Recreation Planning Studies".

Additional recreation studies were made by the Recreation Contract Services Unit for selected reservoirs. The purpose of these studies was to obtain a measure of recreation potential for possible project units under study. For each reservoir area evaluated, a general land use plan was prepared as a basis for estimating the capacity and the costs of the recreation facilities. Estimates of recreation use were also prepared to form a basis for estimating benefits and operation and maintenance costs.

The land use plans were developed from standards similar to those used for the State Water Project. Application of these standards produces a high quality recreation development comparable to the best developments in the State Park System.

The costs of the recreation developments resulting from the application of the standards described above were obtained from unit costs prepared by the Recreation Contract Services Unit. These unit costs, which reflect the experience of the Division of Beaches and Parks on similar developments, are presented in Table 39.

TABLE 39

RECREATION DEVELOPMENT UNIT COSTS

Type of facility	Unit costs
Picnic units, road access	$2,700.00 each
Picnic units, boat access	500.00 each
Camp units	3,000.00 each
Access roads (asphalt)	2.75 per sq. yard
Boat launching ramps, concrete	4.50 per sq. yard
Launching ramp parking	2.00 per sq. yard
Sanitary facilities at ramp	12,000.00 each
Beach improvement	20,000.00 per acre
Landscaping	3,000.00 per acre

Using the costs shown above, an operation and maintenanc cost based on the estimates of recreation use of $0.25 per visitor day, and an annual replacement cost of 3½ percent of capital investment, the present worth of the costs of recreation developments were obtained for a 50-year period. The present worth of the recreation development costs at selected reservoirs is shown in Table 40.

TABLE 40

PRESENT WORTH OF THE RECREATION DEVELOPMENT COSTS
AT SELECTED RESERVOIRS

Reservoir	Present worth of capital costs ($1,000)	Present worth* of O.M.& R. costs ($1,000)	Total present worth ($1,000)
Denniston	217	316	533
Purisima No. 1	2,272	1,016	3,288
Worley	2,643	1,156	3,799
Pigeon Point	5,598	7,200	12,798
Bean Hollow	3,387	4,369	7,756

*50-year period of analysis, 4 percent interest.

Fish and Game

Development of any of the reservoirs under study would displace some fish and game resources. This is particularly true of Pescadero Creek, which supports an anadromous fishery. In order to evaluate the impact of water resources development and to make preliminary studies of ways to mitigate any damage, the Department contracted with the Department of Fish and Game for studies of the fish and game resources of the investigation area. The report on these studies is presented in Appendix C, "Fish and Game Resources". The descriptions of individual dam and reservoir sites in the following section describes specific fish and game problems.

Description of Dam and Reservoir Sites to Be Considered in Formulating the Staged Development Plans

Eleven of the 13 sites remaining after the geologic and relative cost evaluation are suitable for water storage.

The other 2 sites are suitable only for diversion dams. The general criteria used to evaluate the 11 sites are shown above. The following sections present specific details which apply to individual sites.

Denniston Dam and Reservoir (Site No. 2)

Denniston Dam would be located in the southwest quarter of Section 2, Township 5 South, Range 6 West, MDB & M, approximately one mile north of El Granada.

A mathematical operation study was made for a 4,500 acre-foot reservoir. Small mandatory releases were allowed for existing water use and a pool of 250 acre-feet was reserved for sediment deposition and fish. The net yield was 1,300 acre-feet per year.

Recreational development in the reservoir area is now limited to a rifle and pistol range operated by the Brisbane Rod and Gun Club. Poor access, rather steep slopes, limited area available for development, and a lack of trees, make the overall reservoir recreation potential relatively poor.

Fish and Game resources of the watershed are not utilized to any degree. The reservoir would cause the loss of some quail habitat but would not adversely affect other species of wildlife or the small resident trout population. With proper management a self-sustaining population of warmwater game fish could be supported.

Purisima No. 1 Dam and Reservoir (Site No. 9)

Purisima No. 1 Dam would be located in the southeast quarter of Section 16, Township 6 South, Range 5 West, MDB & M, approximately 3.5 miles south of Half Moon Bay.

A mathematical operation study was made for a reservoir with a capacity of 16,800 acre-feet. Allowing a sediment, recreation, and fish pool of 1,000 acre-feet, a net yield of 3,900 acre-feet per year could be obtained.

The reservoir recreation potential is only fair because of the open cover pattern and the scanty tree cover. There are some trees in the canyons, but most of the drier slopes lack even brush cover. Access is good and most recreation uses could be accommodated, but the size of the reservoir would limit the amount of use.

Purisima Creek supports a small self-sustaining population of trout, but because of a natural barrier at the mouth no anadromous fisheries are present. The area also has a fair standing population of upland game. The creek is considered to be one of the best fishing streams in the Half Moon Bay area even though access is limited in the upstream areas.

Purisima No. 2 Dam and Reservoir (Site No. 10)

Purisima No. 2 Dam would be located in the southeast quarter of Section 10, Township 6 South, Range 5 West, MDB & M, about 1.2 miles upstream from the lower axis.

The recreation potential and the utilization of fish and game resources are the same as for Purisima No. 1, except that the recreation area is slightly more attractive.

As a result of a cost comparison, Purisima No. 2 was deleted from consideration in favor of Purisima No. 1.

Lobitos Dam and Reservoir (Site No. 12)

Lobitos Dam would be located in the southwest quarter of Section 22, Township 6 South, Range 5 West, approximately 6 miles south of Half Moon Bay.

Recreation potential is limited by small size, steep slopes, and access. Attractiveness of the area is generally poor. The fish and game resources are similar to those at the Denniston site.

San Gregorio No. 2 Dam and Reservoir (Site No. 16)

San Gregorio No. 2 Dam would be located in the northeast quarter of Section 15, Township 7 South, Range 4 West, approximately 1.6 miles east of State Highway No. 1. One dam with a height of 185 feet and a reservoir capacity of 83,200 acre-feet was investigated.

The overall recreation potential is good, mainly because there are no major access problems and because of the large size of the reservoir. The vegetative cover surrounding the area varies from dense woods to open grasslands. Several areas are suitable for development but would probably require some landscaping.

Loma Mar No. 2 Dam and Reservoir (Site No. 29)

Loma Mar No. 2 Dam would be located on Pescadero Creek in the southwest quarter of Section 4, Township 8 South, Range 4 West, approximately 4 miles east of Pescadero.

The Loma Mar area is attractive, but has only a fair development potential for recreation purposes. Although the reservoir size is suitable for most recreation uses, the upper slopes are steep and the developable areas are few and inaccessible. San Mateo County Memorial Park would be almost totally inundated and Portola State Park partially so. Several private and organizational camp areas would also be inundated.

Pescadero Creek maintains a run of steelhead trout and silver salmon as well as having fish plants of catchable trout each season. The drainage area also supports populations of deer, valley quail, redlegged partridges, waterfowl, and various furbearing mammals. The creek is the most important fishing stream in the area and supports heavy fishing pressure because of its proximity to urban centers. Most of the drainage is posted against hunting, but a considerable amount takes place on lands leased by gun clubs.

To mitigate damage to the existing fisheries, the Department of Fish and Game proposes releases totaling 5,400 acre-feet per year for attraction, transportation, spawning flows, downstream migration, nursery flows, and to assist in opening the sand bar at the mouth of the creek. A fish hatchery with a capacity of 500,000 eggs would also be constructed to compensate for the loss of spawning area. A ladder would be constructed at the downstream diversion dam to allow the passage of the migrating fish.

A mathematical operation study was performed for a reservoir with a capacity of 80,700 acre-feet. Allowing 1,100 acre-feet for downstream releases and 5,400 acre-feet for fish releases, a net yield of 17,000 acre-feet per year was available with a sediment pool of 3,700 acre-feet. If the fish release was not considered, the yield would increase by about 5,400 acre-feet per year.

Worley Dam and Reservoir (Site No. 30)

Worley Dam would be located on Pescadero Creek in the southwest quarter of Section 35, Township 7 South, Range 5 West, approximately 6 miles east of Pescadero.

An operation study was made for a capacity of 27,000 acre-feet, a minimum pool of 2,900 acre-feet, and a fish release of 5,400 acre-feet per year. The net yield is 6,800 acre-feet per year.

The overall recreation potential for the reservoir is fair. Although the site is attractive because of the trees and vegetative cover, there are several detriments. The surrounding slopes are generally steep, the developable areas are limited, and access would be difficult. Reservoirs larger than approximatel 15,000 acre-feet would begin to inundate a small portion of Portola State Park.

The fishery conditions for Worley Reservoir would be the same as for Loma Mar.

Bean Hollow Dam and Reservoir (Site No. 37)

Bean Hollow Dam would be located in Township 8 South, Range 5 West, approximately 2 miles south of Pescadero. Because of its relatively low unit cost of storage, it is being considered for an offstream storage reservoir with diversions from Pescadero and Butano Creeks.

Two mathematical operation studies were made for different diversion capacities. A yield of 10,000 acre-feet per year was obtained from a capacity of 25,000 acre-feet with a diversion of 150 second-feet on Pescadero Creek and a 150 second-foot diversion on Butano Creek. Raising the Pescadero diversion to 250 second-feet and the storage to 72,500 acre-feet increased the yield to 19,600 acre-feet per year. A minimum pool of 3,700 acre-feet was reserved for sediment and recreation.

Lack of tree cover, operation of the reservoir and climatic conditions make the overall reservoir recreation potential poor. There are essentially no fish or game populations in the drainage basin.

Gazos No. 1 Dam and Reservoir (Site No. 39)

Gazos No. 1 Dam would be located in Township 9 South, Range 5 West, approximately 6 miles south of Pescadero. One dam with a reservoir capacity of 48,500 acre-feet was studied for possible inclusion in the offstream storage plan of Pigeon Point Reservoir. Two other reservoir capacities, 21,000 acre-feet and 9,000 acre-feet were investigated primarily for the development of the Gazos Creek Watershed.

The overall potential for recreation development and use is limited by the amount of developable area. Although the cover is adequate and the vegetative pattern attractive, the surrounding slopes are extremely steep and access would be difficult to develop.

Existing fish and game populations consist of a small run of steelhead, deer, quail, and various small furbearing animals.

Pigeon Point Reservoir (Site No. 38)

The Pigeon Point Reservoir would be formed by the construction of embankments at Bean Hollow, site No. 37, and Gazos No. 1, site No. 39. This reservoir would develop the yield of Gazos Creek and would serve as offstream storage for water from Pescadero and Butano Creeks.

A mathematical operation study was made for a reservoir capacity of 121,000 acre-feet with a 500 second-foot diversion on Pescadero Creek and a 150 second-foot diversion on Butano Creek. The resulting yield was 28,000 acre-feet per year.

The recreation potential and existing fish and game populations were described in the sections on Bean Hollow and Gazos No. 1.

Whitehouse Dam and Reservoir (Site No. 41)

Whitehouse Dam would be located in the eastern half of Section 12, Township 9 South, Range 5 West, MDB & M.

The overall recreation potential is considered fair because of the lack of tree cover and the climatic conditions. There are several areas with good access suitable for development. The fish and game resources of the watershed are of minor importance.

Summary of Analysis of Dam and Reservoir Sites Considered in Formulating the Staged Development Plans

The two preceding sections have defined the criteria used to evaluate dam and reservoir units and have described the units evaluated. The results of the evaluations of the dam and reservoir units are summarized in Table 41. More detailed information on these units is presented in Appendix B, "Cost Estimates and Design Data for Selected Dam and Reservoir Sites".

TABLE 41

SUMMARY OF COST ESTIMATES AND DESIGN DATA FOR SELECTED DAM AND RESERVOIR UNITS

Project unit and site number	Crest elevation (feet)	Storage capacity (a.f.)	Net yield (a.f./yr.)	Total estimated capital cost ($1,000)
Denniston Dam & Reservoir (2)	260	6,700	1,500	$ 3,340
	240	4,500	1,300	2,580
	220	2,900	1,100	2,000
Purisima No. 1 Dam & Reservoir (9)	345	16,800	3,900	6,480
	325	11,500	3,400	5,480
	295	5,600	2,700	4,110
Purisima No. 2 Dam & Reservoir (10)	415	11,100	2,900	5,520
	400	8,300	2,500	4,840
	370	3,900	1,800	3,500
Lobitos Dam & Reservoir (12)	370	7,600	1,500	3,860
San Gregorio No. 2 Dam & Reservoir (16)	240	83,200	20,000	15,280
Loma Mar No. 2 Dam & Reservoir (29)	400	95,300	19,500[a]	11,790
	380	80,700	17,000[a]	10,830
	360	64,000	15,000[a]	10,050
Worley Dam & Reservoir (30)	400	37,700	10,000a	9,540
	380	27,000	6,800a	8,120
	360	18,400	3,900a	6,940
Bean Hollow Dam & Reservoir (37)	280	72,500	b	7,850
	250	50,300	b	5,480
	210	29,000	b	4,020
Gazos No. 1 Dam & Reservoir (39)	280	48,500	b	7,780
	220	21,000	4,700	5,350
	180	9,000	3,100	3,750
Pigeon Point Reservoir (38)	280	121,000	b	14,990
Whitehouse Dam & Reservoir (41)	270	7,400	1,500	2,770

a. Does not include 5,400 acre-feet per year fish release.
b. Offstream storage of Pescadero and Butano waters.

Description and Analysis of Offstream Diversion Units

To supply Bean Hollow, Gazos No. 1, or Pigeon Point, it is necessary to divert water from Pescadero and Butano Creeks. Both gravity and pumped diversions are possible.

The pumped diversion unit on Pescadero Creek would consist of a diversion dam and pumping plant at the Pescadero site, site No. 26, and a pipeline to Bean Hollow Reservoir. Pumping plant capacities of 150, 250, and 500 second-feet were evaluated in combination with the pumped diversion on Butano Creek. The Butano Creek pumped diversion unit would consist of a diversion dam and a 150 second-foot pumping plant at the Juanita No. 2 site, site No. 35. Pipelines to both Bean Hollow and Gazos No. 1 were analyzed.

To develop the total dynamic head required for gravity diversion, it was necessary to move the diversion points well upstream from the location of the pumped diversion intakes. The head required for gravity diversion of Pescadero Creek placed the point of diversion above Portola State Park. A 250 second-foot diversion to Bean Hollow was evaluated. The gravity diversion point on Butano Creek would have to be in the vicinity of the Juanita No. 3 site, site No. 36.

The yield produced by a diversion to offstream storage plan is a function of the diversion capacity and the amount of offstream storage available. Mathematical operation studies were made for 4 combinations of diversion capacity and offstream storage. The combinations were generally selected on the basis of yields required for the staged development plans discussed in Chapter VI.

Daily flows at the diversion sites were obtained by applying area-precipitation factors to the daily records at the Pescadero Creek stream gaging station. The operation studies were based on a municipal and industrial demand schedule and included factors for fish releases, mandatory releases, evaporation losses, and precipitation. A minimum pool for sedimentation and recreation was allowed. Figure 1 is a graphic representation of the operation of a 150 second-foot pumped diversion on Pescadero Creek during a relatively wet month. The figure shows the amount of water released for fish and downstream users, the water available for diversion to offstream storage, and the water in excess of diversion capacity which would be passed over the diversion dam.

The diversion capacities and yields of the 4 diversion combinations evaluated are presented in Table 42.

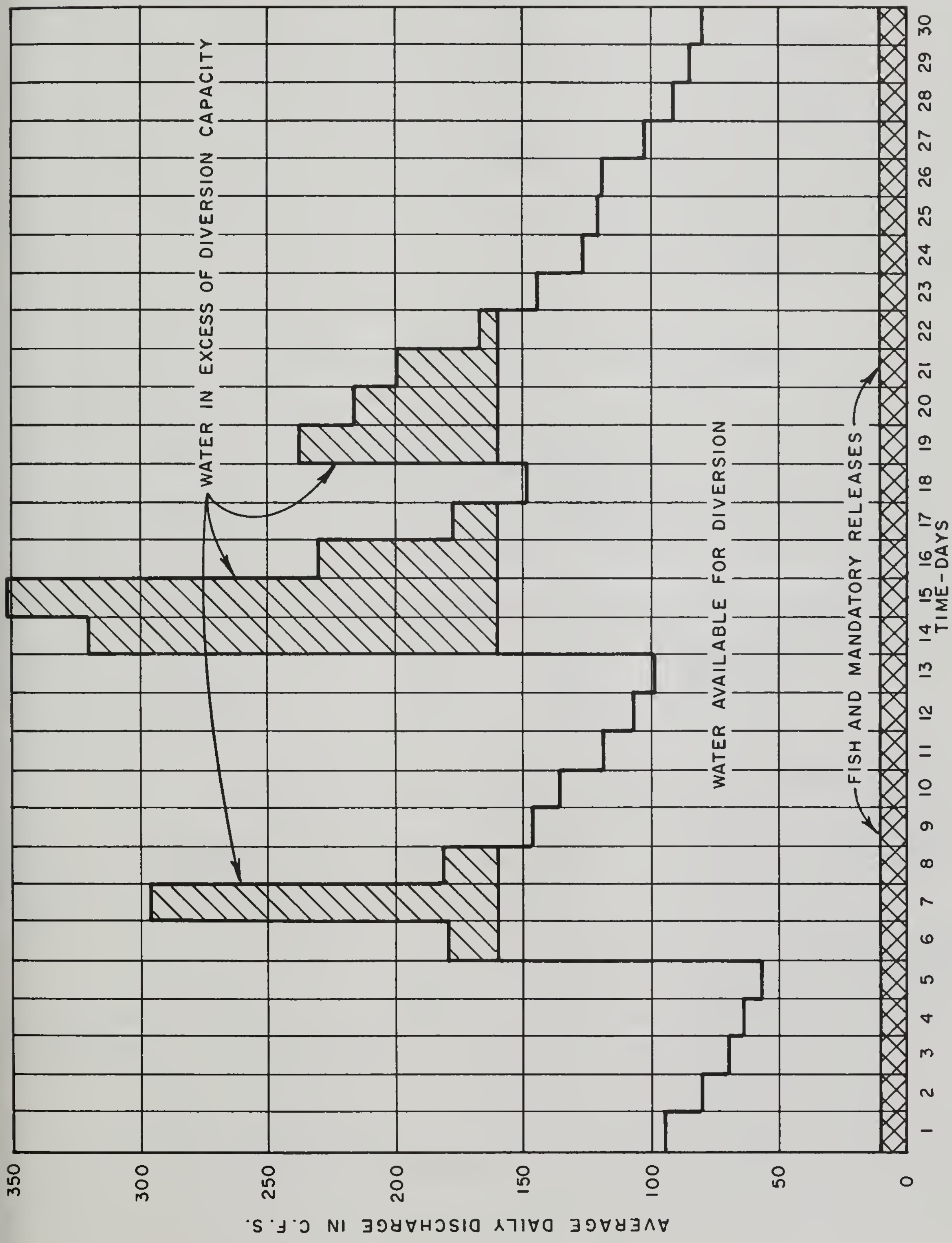
TABLE 42

ANNUAL YIELD OF SELECTED OFFSTREAM DIVERSION PLANS

Diversion plan no.	Type of diversion	Pescadero Creek diversion capacity (cfs)	Butano Creek diversion capacity (cfs)	Offstream storage capacity (a.f.)	Annual yield (a.f.)
A	pumped	150	150	25,000	10,000
B	pumped	250	150	72,500	19,600
C	gravity	250	150	18,000	7,000[a]
D	pumped	500	150	121,000	28,000

a. Maximum yield possible for diversion sites.

FIGURE 1



EXAMPLE OF OPERATION OF PUMPED DIVERSION ON PESCADERO CREEK

The estimated capital costs of the offstream storage reservoirs have already been presented. The estimated capital costs of the diversion units are shown in Table 43. These costs include the cost of the diversion structure, the pumping plant, and the diversion pipeline to the stated offstream storage reservoir. Since Pigeon Point Reservoir is actually Bean Hollow and Gazos No. 1 connected by a channel through the drainage divide, the costs shown for the component reservoirs apply to it.

TABLE 43

ESTIMATED COSTS OF DIVERSION UNITS

Diversion unit	Type of diversion	Pumping plant capacity (cfs)	Diversion pipeline capacity (cfs)	Estimated capital cost ($1,000)
Pescadero Creek to Bean Hollow Reservoir	pumped	150	250	2,100
	pumped	250	250	2,620
	gravity	250	250	4,220
	pumped	500	500	4,040
Butano Creek to Bean Hollow Reservoir	pumped	150	150	1,100
	gravity	150	150	1,110
Butano Creek to Gazos No. 1 Reservoir	pumped	150	150	1,480

The data shown in Tables 42 and 43 indicate that pumped diversions produce more yield at a lower capital cost than do gravity diversions. Pumped diversions do, however, have a relatively large annual energy cost. The choice between the two methods was made on the basis of minimum present worth of the costs of alternative staged development plans based on offstream storage. The smaller yield of the gravity diversion plans made it necessary to construct additional reservoirs during the period of analysis of the staged development plans. The added costs of these additional storage units more than offset the cost of energy and the present worth of the gravity diversion plan was approximately $5 million greater than the pumped diversion plan. This difference is based on private power rates for pumping energy. Public power rates would make the difference even greater. For these reasons, pumped diversion was used in the staged development plans.

Analysis of Possible Conveyance Units

Designs and cost estimates were prepared for conveyance units to determine the cost of delivering water to the major service areas. Project staging necessitated evaluating available design and cost data to arrive at estimates for other alternatives.

The capital cost of the conveyance units was taken as the sum of pipe cost and pumping plant costs. Pipe costs include allowances for the pipe, laying, joining, excavation, backfill, and appurtenances. The pumping plant costs include the pumps and prime movers, buildings, accessory equipment and a sub-statio

Pipes were sized for various flows by a pipe optimization study which considered the pipe costs and the costs of energy required to overcome friction losses. The initial studies were tabulated by capacity, length, maximum design head, and capital cost per foot of pipe. With these parameters, it was possible to develop capital costs for any system of conveyance units required. The estimated costs of the various units considered are included in Table 44.

TABLE 44

ESTIMATED COSTS OF CONVEYANCE UNITS

Pipeline unit	Maximum expected annual use (a.f./yr.)	Length (ft.)	Capital cost ($1,000)
Denniston - Moss Beach	1,500	8,000	90
Purisima No. 1 - Half Moon Bay	3,800	20,000	350
Purisima Creek - Half Moon Bay	14,500	18,000	760
Purisima No. 1 - State Highway No. 1	3,900	4,000	70
Purisima - Half Moon Bay	16,000	18,000	880
Lobitos - Half Moon Bay	1,500	30,000	300
Lobitos - Purisima	10,600	9,000	320
Lobitos - State Highway No. 1	1,500	5,000	50
San Gregorio No. 2 - Half Moon Bay	16,000	51,000	2,700
San Gregorio No. 2 - Half Moon Bay	14,500	51,000	2,400
San Gregorio No. 2 - Pescadero	4,000	30,000	840
Loma Mar - Half Moon Bay	16,000	109,000	5,360
Loma Mar - Half Moon Bay*	8,000	90,000	2,860
Loma Mar - Ano Nuevo	3,500	57,000	1,140
Worley - Half Moon Bay*	6,500	90,000	2,660
Worley - Gazos *	3,000	32,000	480
Worley - Lobitos *	9,100	63,500	2,250
Worley - Ano Nuevo*	4,500	37,000	1,270
Worley - State Highway No. 1*	5,000	18,000	510
Bean Hollow - Half Moon Bay	16,000	90,000	4,480
Bean Hollow - Half Moon Bay	8,000	90,000	2,860
Bean Hollow - Pescadero	2,000	11,000	140
Bean Hollow - Ano Nuevo	1,600	42,000	470
Gazos - Ano Nuevo	1,600	27,000	300
Gazos - Cascade Creek	1,600	17,000	190
Gazos - Pescadero	2,000	40,500	530
Gazos - Pescadero	7,000	43,000	1,200
Gazos - Pescadero	5,000	40,500	810
Gazos - Half Moon Bay	16,000	115,000	5,640
Whitehouse - State Highway No. 1	1,500	4,000	40
Pescadero - Purisima	12,100	54,000	2,160
Pescadero - Ano Nuevo	2,000	50,000	650

*Water diverted from a dam at the Pescadero site.

CHAPTER VI. FORMULATION OF STAGED DEVELOPMENT PLANS

The current and projected development, water utilization, water requirements, and available water supplies of the coastal area of San Mateo County are discussed in Chapters II, III, and IV. Project units which could physically develop and deliver the needed water supplies are described and evaluated in Chapter V. The first half of this chapter presents 6 staged development plans composed of combinations of the project units evaluated in Chapter V.

The topography of the coastal area is such that development will occur in a narrow strip along the coast. This geographical feature requires that all plans meet project requirements in essentially the same way, i.e., store and conserve water in some watershed(s) and distribute it along the coast by means of conveyance pipelines. The 6 plans evaluated meet this requirement and are staged to meet the supplemental water requirements as they develop.

In the second half of this chapter, the benefits and costs of each of the plans are evaluated to determine economic justification. The economically justified plan which appears to offer the opportunity to maximize net benefits and which best meets the needs and desires of the local area, considering all aspects of resources management, is recommended for feasibility study by an area-wide local agency with the powers to implement water resources development.

Development of a firm water supply can be accomplished by use of one of two basic concepts of development. Under the first of these concepts, the estimated maximum supplemental water requirement would be met by construction of relatively large reservoirs in two or three watersheds. This concept would have the advantage of providing the greatest deterrent against inflation and of producing more opportunities for fresh water recreation. It would have the disadvantage of requiring large capital outlays when the demand for water, and the resulting repayment capacity, is small.

The second concept is to construct small reservoirs on several watersheds. This method gains the economic advantages of more staging and smaller initial capital outlays which would tend to minimize financing problems. Disadvantages would be the possibility of increased construction and rights-of-way costs and the chance that urbanization would preclude development of a site.

Comparison of Alternative Combinations of Project Units for Staged Development Plans

The project units described in Chapter V can be combined in a number of staged plans which will meet the ultimate supplemental water requirements of the coastal area of San Mateo County. Since the date at which these requirements will occur is difficult to define, a 50-year period of analysis, from 1970 to 2020, was chosen to form a basis for comparing the alternative plans Each plan is divided into two parts: the units required during the period of analysis and the units required after the year 2020.

The method of comparison selected consisted of defining alternative plans of development which would supply the ultimate supplemental water requirements, staging the units of the plan needed to meet the increasing supplemental requirements during the period of analysis, and determining the present worth of the costs incurred during the period of analysis.

Present Worth

The benefits realized and the costs incurred due to constructing and operating a project must be compared to determine the project's economic justification. In addition, if several possible alternative projects produce the same level of benefits, or if the type and level of benefits vary according to the alternative considered, then the alternative selected for construction should be the one that produces the largest net benefit over the period of analysis in the area under study. Alternative projects include variations in the size and time of construction of a particular project. Usually, anticipated benefits and costs will not accrue at the same time during the period of analysis and, therefore, these values can be compared meaningfully only if they are adjusted to a common time base. This adjustment can be accomplished by discounting all values to their present worth. The point in time selected as the present is arbitrarily selected, usually coinciding with the start of project operations. For this investigation, 1970 is considered the base year and all future benefits and costs of each alternative are discounted to this point in time. The present worth of the benefits and costs of the various alternatives considered are shown in Tables 40, 46, 48, and 49.

Two of the plans involve pumping costs for diverting water to offstream storage. Since the cost of this pumping is appreciable, two power sources were considered. The first of these was private power which is presently available in the area. The second source was public preference power. The potential availability of Northwest and Canadian Treaty power is the basis for the use of public power rates. It was found that there was essentially no difference in the cost of power from the two sources because of the method of operating pumped diversions with large power requirements during periods of high flow. During most months, minimum billing rates which are almost identical for the two sources would apply. Since private power is available in the area, and is slightly less expensive, private power rates were used.

The six alternative plans evaluated are presented in Table 45. Each plan will meet the ultimate supplemental water requirements of the investigation area and each plan is staged to meet the supplemental requirements through the year 2020. Table 45 shows the year construction of each staged project unit is to be completed and the yield of the staged plan when the units are added. The additional storage and diversion units needed to meet ultimate supplemental requirements are also shown. Gross storage is shown for dam and reservoir units, pumping plant capacity is shown for diversion units, and maximum expected annual use is shown for pipeline units. Plans 1 through 4 are shown on Plates 6 through 9, respectively.

TABLE 45

ALTERNATIVE STAGED DEVELOPMENT PLANS

Ye to be co leted	Project Units Dam and reservoir units (gross storage in acre-feet)	 Diversion units (pumping plant capacity in cfs)	 Pipeline units (maximum expected annual use in acre-feet)	Cumulative firm annual yield (acre-feet)
Plan No. 1				
1	Gazos No. 1 (48,500)	-	Gazos-Ano Nuevo (1,600) Gazos-Pescadero (2,000)	4,700
1	-	Butano (150)	Gazos-Half Moon Bay (8,000)	9,600
1	Bean Hollow (72,500)	Pescadero (250)	Bean Hollow-Half Moon Bay (8,000)	19,600
A. Units er 2020	Denniston (6,700)	Enlarged Pescadero (500)		27,500
	Purisima No. 1 (16,800)			31,400
	Lobitos (7,600)			32,900
	Whitehouse (7,400)			34,400
Plan No. 2				
1	Bean Hollow (25,000)	Butano (150)	Bean Hollow-Ano Nuevo (1,600) Bean Hollow-Pescadero (2,000)	3,000
1 5	-	Pescadero (150)	Bean Hollow-Half Moon Bay (8,000)	10,000
1 6	Enlarged Bean Hollow (72,500)	Enlarged Pescadero (250)	-	19,600
1 1	-	-	Bean Hollow-Half Moon Bay (8,000)	19,600
A 1. Units ter 2020	Gazos No. 1 (48,500)	Enlarged Pescadero (500)		27,500
	Denniston (6,700)			29,000
	Purisima No. 1 (16,800)			32,900
	Lobitos (7,600)			34,400
Plan No. 3				
0	Loma Mar No. 2 (95,300)	-	Loma Mar-Ano Nuevo (3,500)	19,500
5	-	-	Loma Mar-Half Moon Bay (8,000)	19,500
1	-	-	Loma Mar-Half Moon Bay (8,000)	19,500
l1. Units ter 2020	Gazos No. 1 (48,500)	Butano (150)		29,000
	Purisima No. 1 (16,800)			32,900
	Denniston (6,700)			34,400
Plan No. 4				
70	San Gregorio No. 2 (83,200)	-	San Gregorio-Ano Nuevo (6,000)	20,000
75	-	-	San Gregorio-Half Moon Bay (14,500)	20,000
dl. Units fter 2020	Gazos No. 1 (48,500)	Butano (150)		29,000
	Purisima No. 1 (16,800)			32,900
	Denniston (6,700)			34,400
Plan No. 5				
70	Worley (27,000)	-	Worley-Ano Nuevo (3,000)	6,800
75	-	-	Worley-Half Moon Bay (16,000)	6,800
77	Purisima No. 1 (16,800)	-	Purisima No. 1-State Highway No. 1 (3,900)	10,700
86	Gazos No. 1 (48,500)	-	Gazos-Pescadero (7,000)	15,400
02	-	Butano (150)	-	19,600
dl. Units after 2020	Bean Hollow (72,500)	Pescadero (400)		34,400
Plan No. 6				
970	Gazos No. 1 (21,000)	-	Gazos-Pescadero (5,000) Gazos-Ano Nuevo (1,600)	4,700
975	Purisima No. 1 (16,800)	-	Purisima-Half Moon Bay (14,500)	8,600
979	Denniston (6,700)	-	Denniston-Moss Beach (1,500)	10,100
982	Lobitos (7,600)	-	Lobitos-Purisima (10,600)	11,600
983	Worley (27,000)	-	Worley-Lobitos (9,100)	18,400
010	Whitehouse (7,400)	-	Whitehouse-State Highway No. 1 (1,500)	19,900
ddl. Units after 2020	Bean Hollow (72,500)	Pescadero (400)		34,400

The 6 alternative plans of development defined in Table 45 reflect the two basic concepts of development defined at the beginning of the chapter and combinations of them. The present worths of the alternatives, using a 4 percent interest rate, are presented in Table 46.

TABLE 46

PRESENT WORTH OF ALTERNATIVE STAGED DEVELOPMENT PLANS*

Plan No.	Present worth of capital costs ($1,000)	Present worth of O.M. & R. ($1,000)	Total present worth ($1,000)
1	16,950	6,390	23,340
2	13,590	6,470	20,060
3	16,560	3,660	20,220
4	18,740	2,510	21.250
5	21,810	4,290	26,100
6	24,340	2,980	27,320

*For the 50-year period of analysis, 1970-2020.

Economic Justification of the Staged Development Plans

The test of economic justification for most public work projects is a ratio of project benefits to project costs in exces of unity. The preceding section presented an evaluation of present worth of the costs of 6 alternative staged development plans which meet the supplemental water requirements through the period 1970-2020. The following paragraphs present an evaluation of the benefits creditable to the plans.

The measure of urban water supply benefits was taken to be the cost of an alternative supply from sources other than the coastal area of San Mateo County. There are three readily apparent methods which could physically supply the required water. The three methods are: the import of North Coast water through the State Water Facilities; seawater conversion by plants located in the coastal area; and the import of Sierra Nevada water through the City of San Francisco's Hetch Hetchy system. The latter alternative is considered to be the most practical and least costly. The City of San Francisco is presently supplying water to the Coastside County Water District, although it does not consider the coastal area to be part of its permanent service area. For the purpose of measuring urban water supply benefits, however, San Francisco water will be considered the alternative source.

Since the Coastside County Water District is presently using San Francisco water, the amount they pay for it is considered a measure of the alternative cost. For the period 1956-57 through 1963-64, Coastside's average weighted cost of water was $82.50 per acre-foot. This charge is for water on Pilarcitos Creek. Distribution costs are additional and would be appreciable for other parts of the investigation area. Use of this amount as the unit benefit for urban water supply gives minimum benefit for this purpose. The present worth of urban water supply benefits for the period 1970 to 2020, using a unit benefit of $82.50 per acre-foot and a 4 percent interest rate, is $12,040,000.

The measure of agricultural water supply benefits is the return to land and water resulting from irrigation. For a given crop, the return to land and water is the difference between gross income per acre and costs per acre. Application of the applied water requirement factor for the given crop puts it on a per acre-foot basis.

Payment capacity is a measure of the price that can be paid for water and still allow a reasonable profit on the farm enterprise. It is defined as the difference between the return to land and water and the return to land. Table 47 summarizes the agricultural economics of the coastal area.

TABLE 47

AGRICULTURAL INCOME, COSTS, AND PAYMENT CAPACITY FOR IRRIGATED CROPS IN THE COASTAL AREA OF SAN MATEO COUNTY

Crop	Applied water requirement a.f./acre	Gross income $/acre	Total costs $/acre	Return to land and water		Payment capacity $/a.f.
				$/acre	$/a.f.	
Brussels Sprouts	1.2	1,220	1,025	195	160	85
Artichokes	1.7	675	600	75	45	30
Misc. Truck	0.75	625	545	80	105	65
Strawberries	3.0	3,120	2,525	595	200	165
Flowers	2.5	4,640	4,055	585	235	174
Irrigated Pasture	2.0	135	110	25	13	8

The present worth of the agricultural water supply benefits was computed by applying the data in Table 47 to the supplemental water requirements for projected crop patterns as determined in Chapter II. The present worth of the agricultural water supply benefits for the period 1970 to 2020, using a 4 perc interest rate, is estimated to be $8,720,000.

The present worths of the recreation development costs for five selected reservoirs were presented in Chapter V. Estimates of recreation use at the selected facilities have also been computed. These estimates of recreation use, presented in ppendix D, together with a distribution of distances traveled y the recreation user, have been used to estimate the recreation enefits by the consumer surplus method. This method measures he recreation benefits from the mileage costs of traveling to nd from the recreation area. The Department uses a minimum alue of $0.50 per visitor-day for day use. This minimum was sed for all reservoirs since their computed values were less. stimates of the present worth of recreation benefits and recreaion costs for a 50-year period and the benefit-cost ratio for ecreation are presented in Table 48.

TABLE 48

RECREATION BENEFITS, COSTS, AND BENEFIT-COST RATIOS

eservoir	Present worth of benefits ($1,000)	Present worth of costs ($1,000)	Benefit-cost ratio
enniston	379	533	0.71
urisima No. 1	2,811	3,288	0.85
orley	1,371	3,799	0.36
igeon Point	10,317	12,798	0.81
ean Hollow	6,190	7,756	0.80

None of the recreation developments evaluated have a favorable benefit-cost ratio under the criteria used. Since the principles of project formulation specify that the separable costs of a project purpose be less than the benefits of that purpose, recreation facilities were not included in the evaluation of the selected alternatives. The consumer surplus method gives relatively low unit values for recreation benefits in the San Francisco Bay Area. Federal agencies have used a minimum value of $1.00 for projects in the Bay area. Although justified recreation development may be possible, the alternative staged development plans are evaluated on the basis of water supply only.

The total present worth of the urban and agricultural water supply benefits for the period 1970 to 2020 is $20,760,000. The benefit-cost ratios for the 6 alternative staged development plans are presented in Table 49.

TABLE 49

BENEFIT-COST RATIOS FOR ALTERNATIVE STAGED DEVELOPMENT PLANS

Plan no.	Present worth of benefits 1970-2020 ($1,000)	Present worth of costs 1970-2020 ($1,000)	Benefit-cost ratio
1	20,760	23,340	0.89
2	20,760	20,060	1.03
3	20,760	20,220	1.03
4	20,760	21,250	0.98
5	20,760	26,100	0.80
6	20,760	27,320	0.76

Multiple Resource Management Considerations

On the basis of the benefit-cost ratio in Table 49, Plans 2 and 3 are economically justified. Since the ratios were computed on a minimum basis--a minimum value for urban water supply benefits and no consideration of possibly justified recreation, flood control, and/or fish and wildlife enhancement purposes--Plans 1 and 4 would probably be justified if given detailed study.

In order to select one of the plans and recommend it for feasibility studies, it is necessary to consider the effects of each plan on all the resources of the coastal area. The plan which least disturbs existing developments and which offers the best opportunity for enhancing the coastal area's resources would be the one recommended. The following paragraphs discuss the advantages and disadvantages of the 4 plans.

Plans 1 and 2 are essentially the same. Both use diversions from Butano and Pescadero Creeks. Under Plan 1 the dam on Gazos Creek would be constructed first, then the dam on Arroyo de los Frijoles (Bean Hollow). Under Plan 2, Bean Hollow would be constructed first and the dam on Gazos Creek would be one of the additional units required to meet the estimated maximum supplemental requirements.

The plans would have the advantages of minor dislocation of existing development and the creation of recreation opportunities where none presently exist. A disadvantage would be the elimination of a very small run of steelhead on Gazos Creek.

During the initial period Plan 1 would offer more reservoir surface area but Plan 2 would offer more lands developable for recreation. Plan 2 would also reduce the amount of land required for project purposes during the initial period. The major drawback to Plan 1 is its less favorable benefit-cost ratio when compared to Plan 2.

On the basis of the foregoing conditions, Plan 2 is considered superior to Plan 1 and Plan 1 is not considered further.

Plan 3 would consist of a large reservoir at the Loma Mar No. 2 site on Pescadero Creek. The dam in this plan would block a major run of steelhead which is considered to be one of the 15 most important runs in Northern California. The reservoir would completely inundate San Mateo County's Memorial Park, several organization campgrounds, and numerous private homes. It would also inundate part of Portola State Park. The damage to these natural resources is considered sufficient to preclude recommendation of this plan.

The recreation potential of Plan 4 is the greatest of the plans considered. Although the plan also offers an opportunity to provide flood protection by reservoir storage, it is believed that channel improvements would be more economica This plan would, however, displace some of the existing recreati connected with the creek. It would also inundate areas used for summer home developments, another form of recreation. The San Gregorio Creek Valley is one of the most attractive and developa areas on the coast. Plan 4 would inundate a large portion of th valley and prevent development. This would lower the potential tax base of the coastal area and the resulting ability to financ the needed water resources development projects.

Recommended Staged Development Plan

Both Plans 2 and 4 can develop the water supplies need for the coastal area of San Mateo County. A comparison of the advantages and disadvantages of the two plans, however, indicates that Plan 2 would provide the needed supplies with the least interruption of other resources. Plan 2 is economically justified under the criteria used for evaluation, while Plan 4 is not justified. For these reasons, Plan 2 is selected and is recommended for feasibility study.

The recommended staged development plan, Plan 2, is based on the diversion of Butano Creek and Pescadero Creek waters to offstream storage in Bean Hollow Reservoir. The units of the plan are presented in Table 45 and are shown on Plate 7.

The initial units of the recommended plan, to be completed in 1970, consist of a 25,000 acre-foot reservoir at Bean Hollow, a 150 second-foot diversion on Butano Creek, and conveyance pipelines to the Ano Nuevo and Pescadero areas.

Increasing demands for supplemental water supplies require completion of a 150 second-foot diversion on Pescadero Creek and a conveyance pipeline to the Half Moon Bay area by 1975. These additional works would increase the firm annual yield of the project from the 3,000 acre-feet supplied by the initial works to 10,000 acre-feet.

In 1986, Bean Hollow Reservoir would be enlarged from 25,000 acre-feet to 72,500 acre-feet and an additional 100 second-feet of pumping plant capacity would be added to the Pescadero Diversion. These works would increase the firm annual yield of the project to 19,600 acre-feet which is the 2020 supplemental water requirement. The final unit required during the 50-year period of analysis would be a second conveyance pipeline to the Half Moon Bay area. This unit would be required in 1991.

In addition to the project units required during the period of analysis to meet the 2020 supplemental water requirements, Plan 2 also includes the additional storage and diversion units needed to meet the ultimate supplemental water requirements. The storage units are Gazos No. 1, 48,500 acre-feet, Purisima No. 1, 16,800 acre-feet, and Denniston, 6,700 acre-feet. A 250 second-foot diversion on Pescadero Creek would be required. The combined yield of all project units in Plan 2 is 34,400 acre-feet, the ultimate supplemental water requirements.

Table 50 presents the project units required during the period of analysis and shows their year of completion, capital cost, and annual operation, maintenance, and replacement cost. The table also lists the additional units required to meet the estimated maximum supplemental water requirements. The relationship between the supplemental water requirements of the coastal area and the yield of the recommended staged development plan is shown graphically in Figure 2.

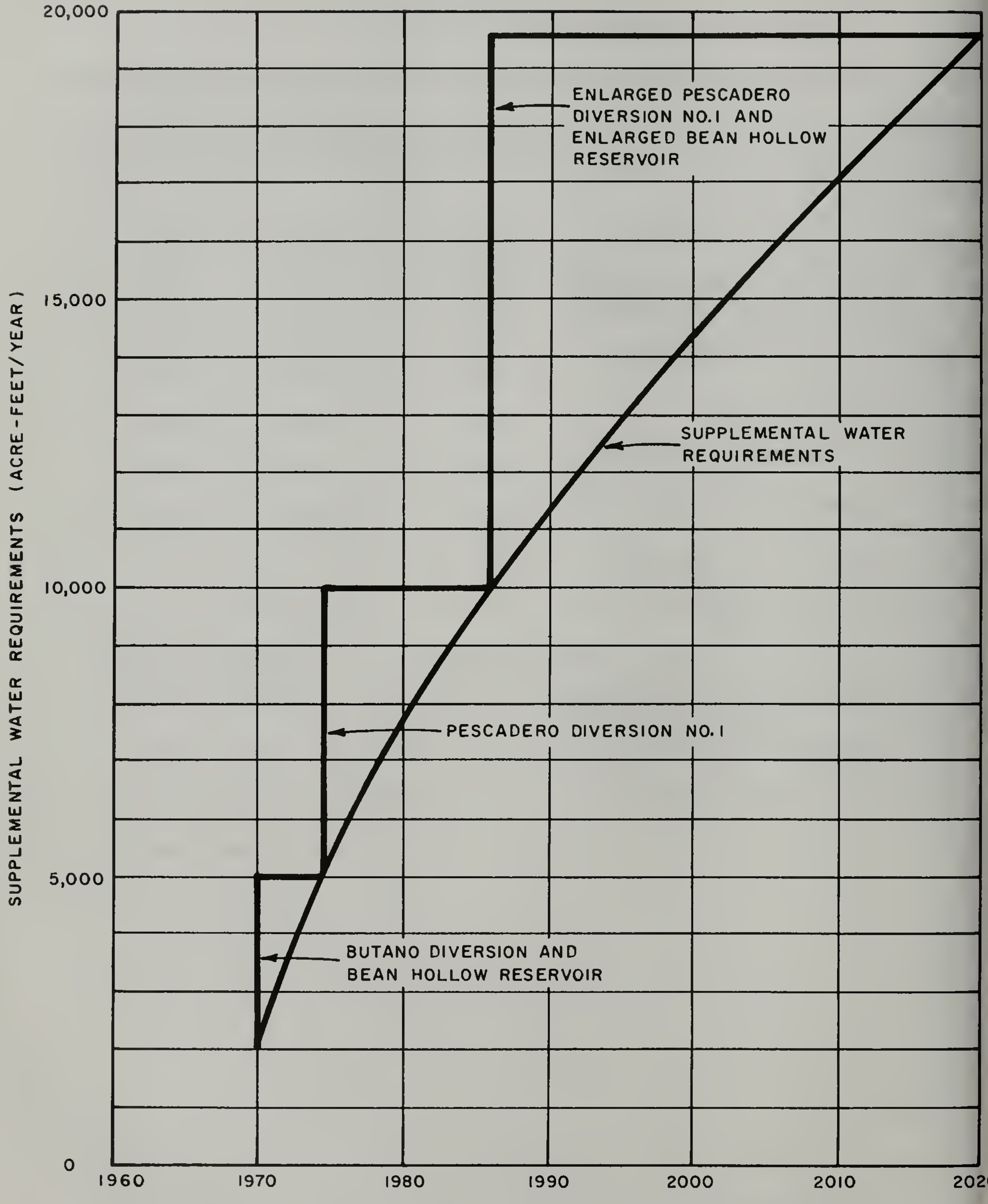
TABLE 50

RECOMMENDED STAGED DEVELOPMENT PLAN

Project unit	Year of completion	Capital cost ($1,000)	Annual O.M. & R cost ($1,000
Units to year 2020			
Bean Hollow Dam & Reservoir	1970	4,020	8.2
Butano Diversion	1970	1,100	55.4
Bean Hollow-Ano Nuevo Pipeline	1970	470	11.6
Bean Hollow-Pescadero Pipeline	1970	140	5.5
Pescadero Diversion No. 1	1975	2,100	113.6
Bean Hollow-Half Moon Bay Pipeline No. 1	1975	2,860	76.8
Enlarged Bean Hollow Dam and Reservoir	1986	4,200	13.1
Enlarged Pescadero Diversion No. 1	1986	520	71.8
Bean Hollow-Half Moon Bay Pipeline No. 2	1991	2,860	76.8
Total capital cost of units required during period of analysis, 1970-2020		18,270	

Additional units required after 2020 to meet estimated maximum supplemental water requirements:

- Gazos No. 1 Dam and Reservoir
- Denniston Dam and Reservoir
- Purisima No. 1 Dam and Reservoir
- Lobitos Dam and Reservoir



PROJECT STAGING TO MEET SUPPLEMENTAL WATER REQUIREMENTS

CHAPTER VII. POSSIBILITIES FOR FINANCING THE STAGED DEVELOPMENT PLAN

The extent and rate of water development in the coastal area of San Mateo County will be controlled by the ability to secure financing for water development projects. To determine the sources of funds available to finance a water development project, it is necessary to have a specific construction proposal for the lending agency to consider. All lending agencies limit the degree of risk they are willing to assume and the purposes for which they will lend money. The test of financial feasibility is, in essence, an examination of the willingness and ability of the borrower to repay the costs. While such an examination is beyond the scope of this bulletin, an appraisal of some of the potential sources of financing is considered appropriate. The potential sources of money are private, state, and federal; some projects may involve all three.

Private Financing

The type and extent of private financing appropriate to any specific project depends upon the scale and nature of the project. For example, individual wells may be financed directly by the owner without recourse to any lending agency; it is very seldom that larger scale projects such as dams and reservoirs can be financed by this means. In the case of projects constructed by organized water districts and cities, capital expenditure programs for water resource development of relatively small magnitude are often financed through current taxes and water sales. Larger scale development programs, however, are financed by the issuance and sale of either general obligation or revenue bonds in nearly all instances. General obligation bonds are backed by the full faith and credit of the issuing agency. Repayment of general obligation bonds is guaranteed by the revenue from the project, plus the taxing power and all sources of revenue of the issuing agency; revenue bonds are repaid by revenues from the specific project for which the bonds were issued.

In general, agencies that would have a direct and overlapping debt, including the cost of the project, of less than about 25 percent of their assessed valuation, can expect to sell bonds at a reasonable interest rate. When outstanding indebtedness exceeds 25 percent, interest rates tend to rise. If the indebtedness becomes great enough the bonds become unsaleable. In general, revenue bonds involve a higher risk and may be expected to bear somewhat higher interest rates than general obligation bonds. The bonding capacity of the investigation area is limited because its assessed valuation is relatively low.

State Financial Assistance

State financial assistance to local water development projects may be available under the Davis-Grunsky Act, Chapter 5 of Part 6, Division 6 of the California Water Code, in the form of loans or grants or both. Under certain circumstances, the State may participate directly in the project.

State Participation

The State may participate in the construction of a project if it appears desirable in the public interest to construct a larger project than required to supply the needs of the local agency proposing development. An example would be the case where an agency proposes to build a small dam and reservoir at the only site well suited for a larger structure to serve additional potential water users, and where construction of the larger project would be mutually beneficial to all parties concerned. In such a situation, the State may take part in planning, designing, constructing, operating, and maintaining the project, and may finance those costs of the project in excess of the cost necessary to meet the requirements of the agency planning the smaller structure. Legislative authorization and specific appropriation of funds are required for State participation.

Loans

The Department of Water Resources, with the prior approval of the California Water Commission, may lend up to 4.0 million dollars for any one project. The project must be primarily for domestic, municipal, agricultural, or industrial purposes, and the loan is limited to that portion of the project that cannot be financed from other sources on reasonable terms. Loans may be made in excess of 4.0 million dollars for projects when so authorized by the Legislature. The principal and interest of these loans must be repaid within a maximum period of 50 years. When justified, a delay of up to 10 years in repayment of the principal of such loans may be authorized to allow for a period of development.

The Davis-Grunsky Act also provides for financial assistance to public agencies for the preparation of feasibility reports on proposed water development projects which have obtaine a favorable preliminary determination of eligibility from the Department of Water Resources. Loans for feasibility reports may be made up to $50,000, provided funds cannot be obtained from other sources on reasonable terms. Such loans, with interest, must be repaid within 10 years, even if the project is found to be infeasible.

After feasibility has been determined and the application is approved, the cost of preparing the detailed construction designs and specifications can also be covered by the loan for the project.

Grants

The Davis-Grunsky Act provides for grants for projects which include a dam and reservoir. These grants may be for the portion of the cost of the dam and reservoir allocated to recreation and the portion of the cost of the project allocated to fish and wildlife enhancement. Additional amounts, not to exceed 25 percent of the sum of the above two grants can be made available for the initial water supply and sanitary facilities required for the recreation area. The Department, with the approval of the California Water Commission, can make grants up to a total amount of $400,000. Larger grants require authorization by the Legislature.

Federal Programs

Various forms of federal financing are available for local water development project assistance. The most significant programs include the Small Reclamation Project Act (Public Law 984), the Watershed Protection and Flood Prevention Act (Public Law 566), the flood control programs of the U. S. Army Corps of Engineers, and Public Facility Loans (Public Law 345). In the first three programs, provisions are made for nonreimbursable federal contributions for multiple-purpose projects involving flood control and wildlife enhancement The second and third Programs also have provision for federal contributions for recreation.

Small Reclamation Project Act

Public Law 984 (84th Congress) provides assistance to small irrigation projects. This law authorizes the Secretary of the Interior, through the Bureau of Reclamation, to lend a maximum of 5 million dollars on a project that does not exceed 10 million dollars. The act also authorizes grants up to 5 million dollars for flood control and fish and wildlife enhancement where benefits to the general public welfare can be substantiated. However, the combination of loan and grant may not exceed the 5 million dollar maximum for any single project.

Grants may be authorized even though no loan is requested, provided irrigation is the primary project purpose and the cost of the irrigation project will be borne by the local interests applying for the grant. The irrigation project may provide a domestic, industrial or municipal water supply, as well as commercial power, provided these functions are incidental to the irrigation project.

That portion of the loan properly allocated to irrigation of lands is interest free except for single ownerships in excess of 160 acres (320 acres for a man and wife under community property laws). Interest must be charged on the reimbursable portion of the project costs chargeable to providing irrigation benefits to lands in excess of 160 acres in a single ownership. Interest must also be charged on the portion of the project costs allocated to commercial power, domestic, industrial, and municipal water uses.

The repayment period will be determined by local economic conditions and must be for the shortest practicable time, but may not exceed 50 years.

Local interests must provide the necessary easements and all costs of lands, and guarantee that it has or can acquire the necessary water rights. Water rights involved in a legal controversy will prohibit the Secretary of the Interior's approval of the loan.

The law further specifies that for projects costing less than 5 million dollars the local interests must provide, from sources other than the federal loan, a part of the project construction costs up to, but not to exceed, 25 percent of the reimbursable costs of the project. For projects costing over 5 million dollars, the local interests must pay all of the costs over 5 million dollars, and must make the contribution that they would have had to make if the project cost had been 5 million dollars.

Local interests are responsible for planning, building, operating, and maintaining the system. The Bureau of Reclamation may be consulted to examine the plans and inspect the construction to determine if the project conforms to Bureau standards.

Watershed Protection and Flood Prevention Act

Public Law 566, enacted by the 83rd Congress, authorizes the United States Secretary of Agriculture, through the Soil Conservation Service, to cooperate with local agencies in the planning and constructing of works for improving, protecting, and developing the land and water resources of small upstream watershed areas or subwatershed areas. These works can be for conservation, utilization, and/or disposal of water.

Under the provisions of this act, about 50 percent of the cost of the dam and reservoir allocated to irrigation, recreation, and fish and wildlife enhancement are covered by nonreimbursable federal contributions. All of the costs allocated to flood control are nonreimbursable. Loans can be made for the reimbursable costs allocated to irrigation and municipal and industrial water supply.

There are certain limitations on the size and costs of Public Law 566 projects. A given reservoir may not store more than 25,000 acre-feet of water. Of this amount, not more than 5,000 acre-feet may be for flood water detention. The maximum federal contribution for a watershed project is 5 million dollars. The maximum loan authorized by Public Law 566 is 5 million dollars also. Repayment of loans is scheduled for the shortest practicable time, but may not exceed 50 years. The repayment period begins when the principal benefits begin to accrue to the project.

Eligibility requirements set forth by the Secretary of Agriculture specify that the local interests must be legally empowered to install, maintain, and operate the works of improvements; have insufficient funds and be unable to borrow the funds from a private source at a reasonable interest rate; be able to pay for the loan; have the legal capacity for obtaining, giving security, and raising revenues for repayment of the loan; and sponsor, co-sponsor, or agree to participate in a watershed work plan as set up by the Soil Conservation Service.

U. S. Army Corps of Engineers Flood Control Projects

As part of its flood control activities, the U. S. Army Corps of Engineers plans, designs, and constructs multiple-purpose dams and reservoirs. Congressional authorizatio is required for both the planning and construction of projects.

Congressional appropriation of funds is required for all three stages.

The portion of the cost of a U. S. Army Corps of Engineers' dam and reservoir allocated to flood control is nonreimbursable. In addition, the specific costs of basic recreation lands and facilities and the joint costs allocated to recreation, up to 25 percent of the total project cost, are also nonreimbursable. The Water Supply Act of 1958 provides for loans for the reimbursable costs. The repayment period for these loans is 50 years. The U. S. Army Corps of Engineers' projects do not have size or total cost limitations.

Public Facility Loans

As authorized under Public Law 345 (84th Congress) the Housing and Home Finance Administrator may purchase securities or make loans to public agencies to finance a project essential to public health and welfare where credit is not otherwise available on reasonable terms. Priority is given to applications of communities of less than 10,000 inhabitants for construction of basic public works for municipal purposes.

Types of Local Organizations

There are numerous types of public districts empowered to deal with matters concerning water resources development. The legal basis of these districts are of two kinds, general act districts and special act districts. General act districts are formed under the provisions set forth in the Water Code for a particular type of district. The regulations for and powers of a particular type of district are defined in the Water Code. All districts of a given kind are subject to the same regulations and have the same powers, except where a change has been made for a particular district by an act of the Legislature. Special act districts are created whole and entire by act of the Legislature. While many districts have similar powers and the same title, such as flood control districts, county flood control and water conservation districts and water agencies, they are the result of separate legislation.

In November 1962, the Assembly Interim Committee on Water published a report entitled, "Study of Water District Laws". This report analyzes the organization, powers, and duties of the 10 most used types of general act districts and of 55 selected special act districts.

A detailed review of the Interim Committee's report, together with a review of the Water Code, and other pertinent publications, led to the conclusion that three types of districts are suitable for meeting the coastal area's water resources development needs. The district types are the county water district, the county flood control and water conservation district, and the flood control district. The first of these types is a general act district; the latter two are special act districts.

The powers of the county water district are very broad. A county water district has the power of eminent domain, can store and distribute water, has the implied power to accomplish ground water replenishment, and can develop and wholesale hydroelectric power if the development is incidental. In addition, it can enter into contracts with the federal government; construct and operate facilities for the collection, treatment, and disposal of sewage; acquire, construct, and operate fire protection facilities; operate recreation facilities incidental to district facilities; and drain and reclaim land.

The powers of special act districts vary, depending on the legislation which created the district. The various districts of a given type do, however, have many powers in common. The powers of county flood control and water conservation districts and flood control districts are similar. In general, these two types of districts have the power of eminent domain, can store and distribute water, and can replenish ground water. They also have the power to enter into contracts with the federal government in connection with projects authorized by the acts that established the districts.

Several types of financing are available to county water districts. They are authorized to issue general obligation bonds, revenue bonds, refunding bonds, formation warrants, and notes. The most common type of financing allowed the two special act districts is the general obligation bond. These bonds are frequently restricted to use by a zone within the district.

Existing Agencies

There are presently three public districts within the investigation area. The San Mateo County Flood Control District includes all of San Mateo County. The Coastside County Water District serves the communities of Half Moon Bay, Miramar, El Granada, and Princeton. The Skyline County Water District serves the areas adjacent to Skyline Boulevard, the approximate eastern boundary of the investigation area.

The two county water districts have the power to develop water needed for their service areas. The San Mateo County Flood Control District is not authorized to levy county-wide taxes. It may, however, establish zones within the district for project purposes. These zones can levy taxes and issue general obligation bonds.

New Agencies Needed for Water Development

To develop the water supplies which will be required by the coastal area of San Mateo County, an area-wide local organization will be needed. There appear to be three ways such an agency could be formed. The first of these would be the extension of one of the existing county water districts to include the entire coastal area. A second possibility would be the formation of a new area-wide county water district. A third way of meeting this need would be the establishment of a zone of the San Mateo County Flood Control District. If this methd was used, it would be necessary to amend the district's act to give it the power to distribute water, a power it does not now have.

The decision as to what type of area-wide district should be formed in the coastal area lies, of course, with the local people. The three types outlined above are possible solutions. The nature of the problem does require an area-wide district of some kind.

CHAPTER VIII. CONCLUSIONS AND RECOMMENDATIONS

The investigation of the water resources of the coastal area of San Mateo County has led to a number of conclusions regarding water problems associated with the future development of the area. The conclusions made from the studies lead to recommended actions necessary to solve anticipated water problems. The conclusions and recommendations resulting from the investigation are presented in the following sections.

Conclusions

Conclusions made as a result of the investigation are:

1. Future urban and agricultural development of the coastal area depends on adequate supplies of firm water and on improved transportation systems.

2. Development of an adequate water supply and transportation system will ultimately result in the urbanization of the major portion of the coastal area. Lands not urbanized will have low population densities and will be used for recreation.

3. The irrigated agricultural economy of the area can be maintained for several decades after 2020 by increasing the production of specialty crops particularly suited to the area.

4. The estimated annual supplemental water requirement of the area for the year 2020 is 19,600 acre-feet. Under

conditions of ultimate development, the supplemental requirement is estimated to be 34,500 acre-feet per year.

5. The water supply of the coastal area is derived from precipitation. The mean annual precipitation is 32 inches. The mean annual runoff is 142,000 acre-feet.

6. The quality of the runoff is adequate for domestic, agricultural, and most industrial uses. Hardness of the water of certain streams might make softening desirable.

7. Essentially nonwater-bearing strata underlies most of the area and the potential for supplying needed water by groundwater development is small.

8. There are adequate damsites in the area to develop reservoirs of sufficient capacity to meet the needs of ultimate development.

9. The coastal area contains several of the most importan fishing streams in the San Francisco Bay Area. Provisions for hatcheries, stream releases, and/or fishery pools will have to be included in any project which affects this resource.

10. A considerable demand for reservoir-associated recreation is present in the area. Individual damsites do, however, present development problems because of inaccessability amount of developable terrain, lack of vegetative and tree cover, and climate.

11. A staged development plan to meet the 2020 supplemental water requirements based on offstream storage of Pescadero Creek and Butano Creek waters in Bean Hollow Reservoir is economically justified.

12. Orderly development of the needed water supplies requires the formation of an area-wide district, which would have the power to conserve and distribute water and to acquire and preserve reservoir sites.

Recommendations

As a result of the conclusions drawn from the studies made during the investigation, it is recommended that:

1. An area-wide district, with powers to conserve and distribute water and to acquire and preserve reservoir sites be formed. Such a district may be entirely new, may be a strengthened existing district, or may be an expanded existing district.

2. The area-wide district or, if such a district is not formed, the County initiate a feasibility study of the recommended staged development plan (Plan 2).

3. The area-wide district insure that sufficient water is available to sustain the growth of the coastal area by adopting and implementing the plan resulting from the feasibility study.

4. The plan resulting from the feasibility study be adopted by the County Planning Commission to assist in protecting reservoir sites.

APPENDIX A

APPLICATIONS TO APPROPRIATE WATER IN THE COASTAL AREA OF SAN MATEO COUNTY

APPLICATIONS TO APPROPRIATE WATER

IN THE COASTAL AREA OF SAN MATEO COUNTY

SEPTEMBER 17, 1964

Application number	Date filed	Present owner	D.W.R. diversion number	Source	Location of point of diversion						Amount and period of diversion	Use	Status
					¼	¼	Sec.	Tp.	R.	B. & M.			
151	100515	Garnett & Jessie T. Simms		San Vicente Creek	NW	SW	03	5S	6W	M	0.165c 4/1-11/1	A	L
3286	030923	Mary De Fremery Atkins et al		New Years Creek	SE	NW	28	9S	4W	M	*0.69c 1/1-12/31 *76a 1/1-5/31	KS	L
3286	030923	Mary De Fremery Atkins et al		New Years Creek	NW	SE	28	9S	4W	M	*0.69c *76a	KS	L
3433	052223	Calabrina Incorporated		Little Butano Creek	SW	SE	30	8S	4W	M	480a 11/1-3/31	I	L
3971	043024	Howard E. Hazeo		McMahon Creek	NW	SW	12	5S	6W	M	0.37c 6/1-10/1	I	L
4104	071924	Division of Beaches & Parks		Peters Creek	NE	NW	08	8S	3W	M	0.028c 11/1-6/15	D	L
4847	112725	Calabrina Incorporated et al		Gazos Creek	NE	NE	11	9S	5W	M	*1.23c 5/1-12/1	KE	L
4847	112725	Calabrina Incorporated et al		Gazos Creek	NW	NW	12	9S	5W	M	*1.23c	KE	L
5671	082927	Butano Land & Development Company		Unnamed Spring	NE	SW	17	8S	4W	M	7100g 1/1-12/31	D	L
5671	082927	Butano Land & Development Company		Unnamed Spring	NE	SE	17	8S	4W	M	16160g	D	L
5671	082927	Butano Land & Development Company		Unnamed Stream	SE	NE	17	8S	4W	M	2400g	D	L
5720	101327	Gilbert & Kathryn Hloom		Unnamed Stream	NE	NE	35	6S	4W	M	4000g /1-12/31	DE	L
5907	051228	La Honda Vista Water Company No. 1		Unnamed Stream	NE	NE	35	6S	4W	M	7000g 1/1-12/31	D	L
6154	011229	Charles J. Kostbade		El Corte De Madera Creek	NW	NW	20	6S	4W	M	0.12c 1/1-12/31	KS	L
6154	011229	Charles J. Kostbade		El Corte De Madera Creek	NW	NW	32	6S	4W	M	0.075c	KS	L
6155	011229	Charles J. Kostbade		3 Unnamed Springs	SW	SE	29	6S	4W	M	*0.05c 1/1-12/31	KS	L
6155	011229	Charles J. Kostbade		Unnamed Spring	SE	SE	29	6S	4W	M	*0.05c	KS	L
6157	011229	William F. Leib		Unnamed Spring	SE	NE	25	6S	5W	M	3000g 1/1-12/31	IS	L
6250	041229	Patricia Gray		Unnamed Stream	NE	NW	28	7S	3W	M	*0.03c 4/1-5/15	KS	L
6250	041229	Patricia Gray		2 Unnamed Streams	NW	NE	28	7S	3W	M	*0.03c	KS	L
6497	112229	Marian Miller Ford		Unnamed Stream	SW	SW	05	7S	4W	M	4550g 1/1-12/31	ID	L
6497	112229	Marian Miller Ford		Unnamed Stream	SE	SE	06	7S	4W	M	200g	ID	L
6498	112229	Marian Miller Ford		El Corte De Madera Creek	NE	SE	06	7S	4W	M	0.08c 1/1-12/31	R	L
6753	072930	California Water Service Company		Bear Gulch Creek	NW	SE	12	6S	4W	M	4.2c 4/15-6/1 140a 12/15-4/15	M	L
8532	010736	Frank Torres et al		San Vicente Creek	SE	SW	03	5S	6W	M	23.5a 12/15-4/15	I	L
8828	111036	County of San Mateo		Pescadero Creek	SE	SW	34	7S	4W	M	0.5c 1/1-12/31	RE	P
9112	091037	Calabrina Inc., A Calif. Corp.		Little Butano Creek	SW	SE	30	8S	4W	M	310a 11/1-5/1	I	L
9678	072639	Sky L'onda Mutual Water Company		La Honda Creek	NW	NE	26	6S	4W	M	0.085c 12/15-3/15	DE	L
11633	112546	E. W. McLellan Company		Frenchman's Creek	SE	SW	17	5S	5W	M	7.5a 11/1-4/30	I	L
11712	013147	John, Mary & Andrew Podesta		Unnamed Stream	NW	SE	09	6S	5W	M	13.4a 12/1-5/1	KS	L
12474	041448	Mary De Fremery Atkins		Pinney Creek	SE	SW	27	9S	4W	M	0.25c 4/1-12/1 30a 4/1-5/31	ID	L
13316	082649	Skyline Ranch, Inc.		Peters Creek	NW	SE	22	7S	3W	M	44a 10/1-5/1	IS	P
13876	080150	Pomponio Ranch		Pomponio Creek	SE	SE	29	7S	4W	M	60a 10/1-5/1	I	L
14313	051751	California Water Service Company		Bear Gulch Creek	NE	NW	14	6S	4W	M	11c 10/1-6/30 2500a 10/1-9/30	M	P
15303	042053	Frank F & Jean M. Latta		Gazos Creek	SW	NW	12	9S	5W	M	1.67c 3/1-1/1	KS	P
15827	040954	John S. & Mary E. Gay		S. Fk. San Pedro Creek	NW	NW	24	4S	6W	M	1.2c 1/1-12/31	H	L
15886	052654	Calabrina, Inc.		Gazos Creek	NE	NE	11	9S	5W	M	0.25c 12/1-1/1	KE	L
15937	063054	John W. & Marjorie K. Dodds		Unnamed Spring	NW	SW	09	8S	5W	M	300g 1/1-12/31	D	L
16013	082754	Tjalling K. & Caroline Dykstra		2 Unnamed Gullies	NE	SW	20	5S	5W	M	*43a 1/1-12/31	SR	P
16013	082754	Tjalling K. & Caroline Dykstra		Unnamed Gully	NW	SE	20	5S	5W	M	*43a	SR	P
16162	120154	North Coast County Water District		Unnamed Spring	NE	SW	24	4S	6W	M	0.47c 12/1-5/31	M	P
16183	121754	Pomponio Ranch		Pomponio Creek	SW	SW	28	7S	4W	M	*0.22c 4/1-11/30 *210a 11/1-5/1	IS	L
16183	121754	Pomponio Ranch		Pomponio Creek	NE	SW	29	7S	4W	M	*0.22c *210a	IS	L
16471	071955	John L. Jr. & Elisabeth C. Mothershead		Unnamed Spring	NW	SW	09	8S	5W	M	300g 1/1-12/31	D	L
16482	072255	Elisabeth C. Mothershead		Unnamed Spring	NW	SW	09	8S	5W	M	4000g 1/1-12/31	D	P
16483	072255	Paul R. & Jean S. Hanna		Unnamed Spring	NW	SW	09	8S	5W	M	4000g 1/1-12/31	D	P
16498	080355	Coastside County Water District		Pilarcitos Creek	NE	NE	10	5S	5W	M	*1.5c 11/1-5/31	MD	P
16498	080355	Coastside County Water District		Unnamed Stream	NW	NE	10	5S	5W	M	*1.5c	MD	P
16512	081055	Erica Nursery, Inc.		Frenchman's Creek	NE	SW	17	5S	5W	M	9.16a 1/1-3/1	I	L
16619	092355	Erica Nursery, Inc.		Apanolio Creek	NW	SW	16	5S	5W	M	0.5a	I	L
16784	121255	Skyline Ranch, Inc.		Unnamed Stream	NE	NE	21	7S	3W	M	0.112c 10/1-5/1 30a 11/1-5/1	IS	P
16944	031556	Silvio, Ella & Andrew I. Gabrielli		Arroyo De En Medio	NE	SW	18	5S	5W	M	0.03c 3/15-7/15	I	L
17083	051056	Coastside County Water District		Frenchman's Creek	NE	NW	20	5S	5W	M	2450a 11/1-5/1	ID	P
17083	051056	Coastside County Water District		Pilarcitos Creek	SW	SW	11	5S	5W	M	2010a	ID	P
17083	051056	Coastside County Water District		Mills Creek	NE	SE	34	5S	5W	M	2550a	ID	P
17083	051056	Coastside County Water District		Purisima Creek	SW	SE	02	5S	5W	M	2750a	ID	P
17083	051056	Coastside County Water District		Arroyo Leon	SW	NW	02	6S	5W	M	1200a	ID	P
17198	072456	Mario & Rita Giannini		Big Butano Creek	SW	SE	14	8S	5W	M	7a 12/1-6/30	I	P
17230	081056	Joseph M. Reiter		Green Oaks Creek	NE	NE	29	9S	4W	M	151a 12/1-4/1	I	P
17230	081056	Joseph M. Reiter		Green Oaks Creek	NW	NE	29	9S	4W	M	26a	I	P
17361	111956	County of San Mateo		Pescadero Creek	SW	SW	34	7S	4W	M	*125g 1/1-12/31 * 9a 12/1-4/30	R	P
17361	111956	County of San Mateo		Pescadero Creek	SE	SE	33	7S	4W	M	*125g * 9a	R	P
17361	111956	County of San Mateo		Pescadero Creek	SE	SW	33	7S	4W	M	*125g * 9a	R	P
17568	042457	Catherine B. Steele		Green Oaks Creek	SW	SW	21	9S	4W	M	0.5c 1/1-12/31 15a 11/1-4/30	ID	P
17569	042457	Catherine B. Steele		Green Oaks Creek	SW	NW	29	9S	4W	M	73a 11/1-4/30	I	P
17573	042657	Worden W. & Betty May Steele		Green Oaks Creek	SW	SW	21	9S	4W	M	0.5c 2/1-11/30 15a 11/1-4/30	I	P
17574	042657	Worden W. & Betty May Steele		Green Oaks Creek	SW	NW	29	9S	4W	M	73a 11/1-4/30	I	P
17590	050957	Guido Bianchi		Big Butano Creek	SW	NW	14	8S	5W	M	57a 12/1-4/1	I	P
17643	061157	George Chalfant		Unnamed Stream	SW	SE	33	6S	5W	M	1.5a 1/1-6/1	S	L
17740	072557	San Mateo County Girl Scouts Council		Girl Scout Creek	SW	NW	20	8S	4W	M	12000g 1/1-12/31 0.12a 1/1-12/31	D	P
17825	091757	Skylawn Memorial Gardens		Albert Canyon	SE	NE	23	5S	5W	M	200a 11/1-6/1	I	P
17939	011458	Skyline Ranch, Inc.		Unnamed Stream	NE	SE	22	7S	3W	M	5a 10/1-5/1	KS	P
18058	032158	Coastside County Water District		Frenchmans Creek	NE	SW	08	5S	5W	M	2450a 11/1-5/1	DM	P
18058	032158	Coastside County Water District		Pilarcitos Creek	SE	SW	11	5S	5W	M	2010a	DM	P
18058	032158	Coastside County Water District		Mills Creek	NE	SE	34	5S	5W	M	2550a	DM	P

For explanation of symbols, see last page of [illegible]

Application number	Date filed	Present owner	D.W.R. diversion number	Source	Location of point of diversion						Amount and period of diversion				Use	Status
					1/4	1/4	Sec.	Tp.	R.	B. & M.						
18058	032158	Coastside County Water District		Purisima Creek	SW	SE	02	5S	5W	M			2750a		DM	P
18058	032158	Coastside County Water District		Arroyo Leon	SW	NW	02	6S	5W	M			1200a		DM	P
18161	052858	Sky L'onda Mutual Water Company		La Honda Creek	NE	NE	26	6S	4W	M			20a	3/1-6/1	DE	L
18508	012759	Resources Research, Inc.		Purisima Creek	SW	SE	02	6S	5W	M	0.38c	1/1-12/31			KU	P
18864	072159	Ida & Fiore Divecchio		Unnamed Stream	SE	NE	08	6S	5W	M			90a	11/1-3/31	I	P
19016	100559	Frank P. & Phyllis E. Guerre		La Honda Creek	NW	NW	11	7S	4W	M	2500g	1/1-12/31			DS	P
19311	031660	Theodore J. & Hazel P. Cochrao		Lobitos Creek	NW	SW	27	6S	5W	M	2000g	1/1-12/31			DS	P
19438	051360	Manuel & Doris Gonsalves		Frenchmans Creek	SE	SW	17	5S	5W	M			33a	11/1-2/28	IS	P
19473	060360	Calabrina, Inc.		Butano Creek	NE	NW	09	8S	5W	M	1.5c	4/15-12/1			ID	P
19474	060360	Calabrina, Inc.		Unnamed Stream	SW	SE	27	8S	5W	M			12a	10/1-5/31	I	P
19551	071460	Maurice Oppenheimer		Butano Creek	SW	SE	14	8S	5W	M	*0.5c	1/1-12/31	* 50a	12/1-3/1	KS	P
19551	071460	Maurice Oppenheimer		Unnamed Stream	SE	SW	13	8S	5W	M	*0.5c		* 50a		KS	P
19846	111660	C. A. Carpy & M. Carpy Cooolly		Pescadero Creek From	SE	SE	04	8S	5W	M	*1.8c	5/1-4/30			IV	P
19846	111660	C. A. Carpy & M. Carpy Cooolly		Pescadero Creek To	SW	SE	04	8S	5W	M	*1.8c				IV	P
19846	111660	C. A. Carpy & M. Carpy Cooolly		Pescadero Creek	SW	SE	04	8S	5W	M			25a	1/1-4/30	IV	P
19847	111660	J. O, Pietro & Eva Nunziati		Pescadero Creek From	SE	SE	04	8S	5W	M	*1.6c	5/1-12/31			IV	P
19847	111660	J. O, Pietro & Eva Nunziati		Pescadero Creek To	SW	SE	04	8S	5W	M	*1.6c				IV	P
19847	111660	J. O, Pietro & Eva Nunziati		Pescadero Creek	SW	SE	04	8S	5W	M			25a	1/1-4/30	IV	P
20266	061961	Peter, Peter M. & Abigael A.Folger		Woodruff Creek	SE	NW	12	7S	4W	M	0.20c	10/1-6/1	15a	11/1-6/1	KX	P
20266	061961	Peter, Peter M. & Abigael A.Folger		Woodruff Creek	SE	NE	11	7S	4W	M	0.20c		15a		KX	P
20266	061961	Peter, Peter M. & Abigael A.Folger		Unnamed Stream	NE	SE	11	7S	4W	M	0.16c		15a		KX	P
20273	062061	Estate of Flora E. Steele		Ano Nuevo Creek	NW	SE	28	9S	4W	M			50a	11/1-4/30	I	P
20327	072661	Frank F. & Jean M. Latta		Gazos Creek	SE	NE	11	9S	5W	M	2.83c	1/1-12/31	*363a	11/1-4/30	KY	P
20327	072661	Frank F. & Jean M. Latta		Steele Gulch	NW	SW	12	9S	5W	M			*363a		KY	P
20327	072661	Frank F. & Jean M. Latta		Stage Road Gulch	SW	SW	12	9S	5W	M			*128a		KY	P
20374	083061	C. Dan & Thelma A. Lange		Yankee Jim Gulch	NE	SE	33	8S	5W	M	0.25c	1/1-12/31			KS	P
20568	012262	Arthur G. Manzo & Martin J.Sweeney		Tunitas Creek	NW	NW	03	7S	5W	M			600a	11/1-5/1	IZ	
20711	040562	Thelma Adair Keyes		Butano Creek	NE	NW	15	8S	5W	M			40a	12/1-6/1	I	P
20995	102562	County of San Mateo		Pescadero Creek	SE	SW	34	7S	4W	M	7000g	5/15-9/30	4.75a	5/15-6/30	R	P
21163	021563	Martin J. Bioioo		McCormick Creek	SW	NE	34	7S	4W	M	0.14c	1/1-12/31			ID	P
21291	052763	John M. & Gail W. Davidson		Unnamed Creek	SE	SW	27	6S	5W	M			20a	12/1-4/	IS	P
21293	052863	S.Victor Capps & Albert A. Dunn		Unnamed Stream	SW	NE	03	8S	5W	M			48.9a	10/1-5/3	I	P
21469	092363	John Throckmortoo		Kingston Creek	NE	SE	20	7S	4W	M	0.3c	1/1-12/31	50a	10/1-6/1	KZ	
21470	092363	John Throckmortoo		Unnamed Stream	SW	NE	21	7S	4W	M	0.6c	1/1-12/31	50a	10/1-6/1	KZ	

EXPLANATION OF ENTRIES

USE:
A Agricultural
B Mining
C Milling
D Domestic
E Fire protection
F Flood control
G Dust control
H Fish culture
I Irrigation
J Industrial
K Irrigation, domestic
L Salinity control
M Municipal
N Navigation
O Stockwatering, fish culture
P Power
Q Recreational fire protection
R Recreational
S Stockwatering
T Recreational, fire protection fish culture
U Stockwatering, fire protection
V Recreational, fish culture
W Wildlife propagation
X Recreational, stockwatering
Y Recreational, stockwatering, fish culture
Z Uses too numerous to list or not included in code.

STATUS:
No entry - Application
P - Permit
L - License

* Indicates alternate points of diversion under this application and the amount listed may be diverted from this or other point or points of diversion identified by the same symbol under this application number.

c - cubic feet per second
g - gallons per day

62434 4-62 300 SPO

APPENDIX B

COST ESTIMATES AND DESIGN DATA FOR SELECTED DAM AND RESERVOIR SITES

APPENDIX B

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COST ESTIMATE AND DESIGN DATA FOR DENNISTON DAM AND RESERVOIR

Stream: Denniston Creek
Location: SW $\frac{1}{4}$, Sec. 2, T5S, R6W
Drainage Area: 3.0 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	260	240	220
Height of dam above streambed(feet)	140	120	100
Normal water surface elevation	253	233	213
Storage capacity in acre-feet	6,700	4,500	2,900
Water surface area in acres	120	100	80
Minimum pool in acre-feet	250	250	250
Spillway capacity in cfs	1,700	1,700	1,700
Net yield in acre-feet/year	1,500	1,300	1,100
Estimated Cost			
Dam	$1,680,000	$1,230,000	880,000
Spillway	530,000	440,000	370,000
Outlet Works	140,000	140,000	140,000
Rights-of-Way	160,000	140,000	120,000
Road Relocation	-	-	-
Engineering and Contingencies	830,000	630,000	490,000
Total	$3,340,000	$2,580,000	$2,000,000

COST ESTIMATE AND DESIGN DATA FOR PURISIMA NO. 1 DAM AND RESERVOIR

Stream: Purisima Creek
Location: SE$\frac{1}{4}$, Sec. 16, NE$\frac{1}{4}$, Sec. 21, T6S, R5W
Drainage Area: 8.2 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	345	325	295
Height of dam above streambed(feet)	185	165	135
Normal water surface elevation	330	310	280
Storage capacity in acre-feet	16,800	11,500	5,600
Water surface area in acres	300	240	150
Minimum pool in acre-feet	1,000	1,000	1,000
Spillway capacity in cfs	6,200	6,200	7,400
Net yield in acre-feet/year	3,900	3,400	2,700
Estimated Cost			
Dam	$2,910,000	$2,180,000	$1,320,000
Spillway	680,000	610,000	590,000
Outlet Works	150,000	130,000	120,000
Rights-of-Way	480,000	440,000	400,000
Road Relocation	650,000	650,000	650,000
Engineering and Contingencies	1.610,000	1,470,000	1,030,000
Total	$6,480,000	$5,480,000	$4,110,000

COST ESTIMATE AND DESIGN DATA FOR PURISIMA NO. 2 DAM AND RESERVOIR

Stream: Purisima Creek
Location: SE¼, Sec. 10, T6S, R5W
Drainage Area: 6.5 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	415	400	370
Height of dam above streambed(feet)	165	150	120
Normal water surface elevation	405	390	360
Storage capacity in acre-feet	11,100	8,300	3,900
Water surface area in acres	200	170	110
Minimum pool in acre-feet	1,000	1,000	1,000
Spillway capacity in cfs	4,500	4,500	6,300
Net yield in acre-feet/year	2,900	2,500	1,800
Estimated Cost			
Dam	$2,820,000	$2,260,000	$1,320,000
Spillway	400,000	470,000	530,000
Outlet Works	130,000	120,000	100,000
Rights-of-Way	350,000	330,000	290,000
Road Relocation	300,000	300,000	300,000
Engineering and Contingencies	1,520,000	1,360,000	1,030,000
Total	$5,520,000	$4,840,000	$3,570,000

COST ESTIMATE AND DESIGN DATA FOR LOBITOS DAM AND RESERVOIR

Stream: Lobitos Creek
Location: SW¼, Sec. 22, T6S, R5W
Drainage Area: 3.3 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	370
Height of dam above streambed(feet)	170
Normal water surface elevation	360
Storage capacity in acre-feet	7,600
Water surface area in acres	120
Minimum pool in acre-feet	250
Spillway capacity in cfs	2,300
Net yield in acre-feet/year	1,500
Estimated Cost	
Dam	$1,510,000
Spillway	880,000
Outlet Works	190,000
Rights-of-Way	80,000
Road Relocation	250,000
Engineering and Contingencies	950,000
Total	$3,860,000

COST ESTIMATE AND DESIGN DATA FOR SAN GREGORIO NO. 2 DAM AND RESERVOIR

Stream: San Gregorio Creek
Location: NE¼, Sec. 15, NW¼, Sec. 14, T7S, R4W
Drainage Area: 48.7 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	240
Height of dam above streambed(feet)	185
Normal water surface elevation	227
Storage capacity in acre-feet	83,200
Water surface area in acres	1,140
Minimum pool in acre-feet	4,000
Spillway capacity in cfs	9,200
Net yield in acre-feet/year	20,000
Estimated Cost	
Dam	$7,460,000
Spillway	480,000
Outlet Works	170,000
Rights-of-Way	1,920,000
Road Relocation	1,460,000
Engineering and Contingencies	3,790,000
Total	$15,280,000

COST ESTIMATE AND DESIGN DATA FOR LOMA MAR NO. 2 DAM AND RESERVOIR

Stream: Pescadero Creek
Location: SW¼, Sec. 4, T8S, R4W
Drainage Area: 44.0 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	400	380	360
Height of dam above streambed(feet)	280	260	240
Normal water surface elevation	388	367	345
Storage capacity in acre-feet	95,300	80,700	64,000
Water surface area in acres	840	770	690
Minimum pool in acre-feet	4,000	3,700	3,700
Spillway capacity in cfs	8,200	9,200	9,200
Net yield in acre-feet/year w/fish release	19,500	17,000	15,000
Net yield in acre-feet/year w/o fish release	24,900	22,400	19,400
Estimated Cost			
Dam	$4,600,000	$3,790,000	$3,090,000
Spillway	430,000	610,000	820,000
Outlet Works	220,000	190,000	170,000
Fish Hatchery	190,000	190,000	190,000
Rights-of-Way	2,230,000	2,160,000	2,080,000
Road Relocation	1,220,000	1,220,000	1,220,000
Engineering and Contingencies	2,900,000	2,670,000	2,480,000
Total	$11,790,000	$10,830,000	$10,050,000

COST ESTIMATE AND DESIGN DATA FOR WORLEY DAM AND RESERVOIR

Stream: Pescadero Creek
Location: SW$\frac{1}{4}$, Sec. 35, T7S, R5W
Drainage Area: 38.0 square miles
Type: Earthfill

Crest Elevation(feet above sea level)	440	400	360
Height of dam above streambed(feet)	240	200	160
Normal water surface elevation	422	379	336
Storage capacity in acre-feet	50,200	27,000	13,000
Water surface area in acres	670	420	250
Minimum pool in acre-feet	2,900	2,900	2,900
Spillway capacity in cfs	17,000	20,400	26,400
Net yield in acre-feet/year w/ fish release	12,100	6,800	2,600
Net yield in acre-feet/year w/o fish release	17,500	12,200	8,000
Estimated Cost			
Dam	$7,930,000	$5,540,000	$3,540,000
Spillway	1,020,000	920,000	1,090,000
Outlet Works	180,000	160,000	140,000
Fish Hatchery	190,000	190,000	190,000
Rights-of-Way	450,000	310,000	210,000
Road Relocation	-	-	-
Engineering and Contingencies	3,180,000	2,320,000	1,680,000
Total	$12,950,000	$9,440,000	$6,850,000

COST ESTIMATE AND DESIGN DATA FOR BEAN HOLLOW DAM AND RESERVOIR *

Stream: Arroyo de los Frijoles
Location: T8S, R5W
Drainage Area: 3.2 square miles
Type: Earthfill

Creat Elevation(feet above sea level)	280	250	210
Height of dam above streambed(feet)	260	230	190
Normal water surface elevation	270	240	200
Storage capacity in acre-feet	72,500	50,300	29,000
Water surface area in acres	850	650	430
Minimum pool in acre-feet	3,700	3,700	3,600
Spillway capacity in cfs	2,200	2,200	2,200
Estimated Cost			
Dam	$3,990,000	$2,570,000	$1,650,000
Spillway	430,000	400,000	530,000
Outlet Works	240,000	220,000	190,000
Dikes	300,000	200,000	-
Rights-of-Way	580,000	580,000	580,000
Road Relocation	150,000	-	-
Engineering and Contingencies	2,160,000	1,510,000	1,070,000
Total	$7,850,000	$5,480,000	$4,020,000

*Offstream storage reservoir with yield developed by diversion.

COST ESTIMATE AND DESIGN DATA FOR GAZOS NO. 1 DAM AND RESERVOIR

Stream:	Gazos Creek
Location:	T9S, R5W
Drainage Area:	11.0 square miles
Type:	Earthfill

Crest Elevation(feet above sea level)	280	220	180
Height of dam above streambed(feet)	240	180	140
Normal water surface elevation	270	210	170
Storage capacity in acre-feet	48,500	21,000	9,000
Water surface area in acres	620	360	190
Minimum pool in acre-feet	3,700	2,000	1,200
Spillway capacity in cfs	2,200	2,500	5,300
Net yield in acre-feet/year	-	4,700	3,100
Estimated Cost			
Dam	$3,150,000	$1,820,000	$ 990,000
Spillway	1,360,000	1,130,000	870,000
Outlet Works	170,000	150,000	130,000
Rights-of-Way	390,000	250,000	160,000
Road Relocation	680,000	680,000	680,000
Engineering and Contingencies	2,030,000	1,320,000	920,000
Total	$7,780,000	$5,350,000	$3,750,000

COST ESTIMATE AND DESIGN DATA FOR PIGEON POINT RESERVOIR *

Stream:	Arroyo de los Frijoles and Gazos Creek
Location:	T8S, R5W
Drainage Area:	14.2 square miles
Type:	Earthfill

Crest Elevation(feet above sea level)	280	250	210
Height of dam above streambed(feet)			
Bean Hollow	260	230	190
Gazos No. 1	240	210	170
Normal water surface elevation	270	240	200
Storage capacity in acre-feet	121,000	81,500	44,500
Water surface area in acres	1,500	1,200	800
Minimum pool in acre-feet	3,700	3,700	3,700
Spillway capacity in cfs	2,200	2,200	2,200
Estimated Cost			
Dam			
Bean Hollow	$3,990,000	$2,560,000	$1,650,000
Gazos No. 1	3,150,000	2,350,000	1,490,000
Spillway	430,000	400,000	530,000
Outlet Works	410,000	390,000	330,000
Dikes	300,000	200,000	-
Rights-of-Way	890,000	735,000	475,000
Road Relocation	2,000,000	2,000,000	2,000,000
Engineering and Contingencies	3,820,000	3,105,000	2,635,000
Total	$14,990,000	$11,740,000	$ 9,110,000

*Offstream storage reservoir with yield developed by diversion.

COST ESTIMATE AND DESIGN DATA FOR WHITEHOUSE DAM AND RESERVOIR

Stream:	Whitehouse Creek
Location:	E½, Sec.12, T9S, R5W
Drainage Area:	3.6 square miles
Type:	Earthfill

Crest Elevation(feet above sea level)	270
Height of dam above streambed(feet)	250
Normal water surface elevation	263
Storage capacity in acre-feet	7,400
Water surface area in acres	160
Minimum pool in acre-feet	280
Spillway capacity in cfs	950
Net yield in acre-feet/year	1,500

Estimated Cost	
Dam	$1,600,000
Spillway	230,000
Outlet Works	160,000
Rights-of-Way	90,000
Road Relocation	-
Engineering and Contingencies	690,000
Total	$2,770,000

APPENDIX C

FISH AND GAME RESOURCES

SOME EFFECTS OF POTENTIAL WATER PROJECTS ON THE FISH AND WILDLIFE OF SAN MATEO COUNTY COASTAL STREAMS

****

by

Emil J. Smith, Jr.
Fishery Biologist III

Under the supervision of

George W. McCammon
Fishery Biologist IV

and

J. C. Fraser
Chief

WATER PROJECTS BRANCH

JUNE 1964

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INTRODUCTION

INTRODUCTION

This report contains data compiled during a reconnaisance survey of the fish and wildlife resources of the coastal ection of San Mateo County, with specific reference to the enniston, Purisima, Pescadero, and Gazos Creek drainages. The ata gathered for this study are used to evaluate the effects of esently proposed and future water development projects in the ea.

The San Mateo County streams and their watersheds, lthough small in size when compared to many streams in other reas of the State, are becoming increasingly important as ecreational areas for the growing populations of the San Francisco ay metropolitan complex. Many of the streams in the county are ompletely dominated by private holdings, allowing no public access o the waters. An exception to the general rule of private stream oldings is Pescadero Creek, which has two public recreation areas ordering the stream and several youth group camp areas. The ajor outdoor activities in the area are picnicking, camping, and ishing for trout, both resident and anadromous, and silver salmon. ll of the streams studied have resident trout populations and, here sufficient fishing pressure and access are guaranteed, the epartment of Fish and Game plants catchable-sized trout to ugment natural trout production.

Authorization for Study

The streams along the San Mateo County coast are urrently under investigation for potential water development by the Department of Water Resources. During 1963-64, the Departmen of Water Resources entered into an interagency agreement with the Department of Fish and Game for personnel to evaluate the effects of proposed water projects on the present fish and game resources of the area. A total of $3,000 was furnished for the study under Interagency Agreement Number 252851.

Scope and Objectives of the Study

The objectives of the fish and wildlife study of the coastal drainages of San Mateo County are as follows:

1. Conduct a preliminary reconnaissance of potential water development sites and make a broad survey of the fresh water and anadromous fishery and game resources of the area.

2. Conduct a specific reconnaissance of the fish and wildlife resources and problems that may be brought about by the construction of reservoirs on Denniston, Purisima, Pescadero, and Gazos Creeks.

3. Make recommendations for protective measures and enhancement of fish and wildlife at all presently authorized and proposed projects on the four streams under investigation

The primary purpose of the study was to furnish project engineers with a guideline for evaluating the effects of potentia projects on the fish and wildlife in the county. In addition, a general coverage was given to drainages in the area that are known to support small runs of anadromous fish.

Related Reports and Investigations

There are little published data pertaining to the streams in the coastal portion of San Mateo County. The two reports available, on streams in the area, were prepared by consulting engineers and deal primarily with proposed water development projects.

A report was prepared by the Kennedy Engineers Co. for the Coastside Water District on the feasibility of the Pilarcitos Water Supply Project of which Purisima Creek is an integral part. The report did not take into consideration fish and wildlife values when making recommendations for the project.

A second report, covering a stream in the project area, has been prepared by the consulting firm of George S. Nolte for the County of San Mateo. The report explored the feasibility of a water development project on Pescadero Creek and suggested additional planning assistance be requested from the State Soil Conservation Commission under Public Law 566. The preliminary plans for the development of Pescadero Creek recognize recreation and fishing as a benefit to the project. Preliminary recommendations made by the Department of Fish and Game for the preservation of fish and wildlife were included in the report.

DENNISTON CREEK

Description of the Denniston Creek Watershed

Physical Data

The Denniston Creek watershed is located in the northern part of San Mateo County (Plate C1). The stream originates in the Montara mountains of the Coast Range at an elevation ranging between 1,400 and 1,500 feet and flows westerly and then south, emptying into Half Moon Bay at the town of Princeton Denniston Creek is a spring-fed stream that has a fair year-round flow. A small lagoon at the mouth of the stream (Figure 1) opens and closes throughout the summer.

The upper part of the drainage basin is generally rugged and steep. The open hillsides are covered with dense growths of Chaparral (Figure 2), while the canyon bottoms and the north and east facing slopes are clothed in a redwood complex with madrone, alders, and willows common near the stream The willow-shaded middle section of the stream flows through a narrow, cultivated valley and terminates in a small reservoir (Figures 3 and 4) The section of stream below the reservoir flows across the narrow coastal plain, where a dense growth of blackberry vines is entangled in streamside willows.

Land Use

The land along the middle section of Denniston Creek is planted in specialty crops, consisting of water cress, flower bulbs, and brussel sprouts (Figures 2 and 3) The crops in the

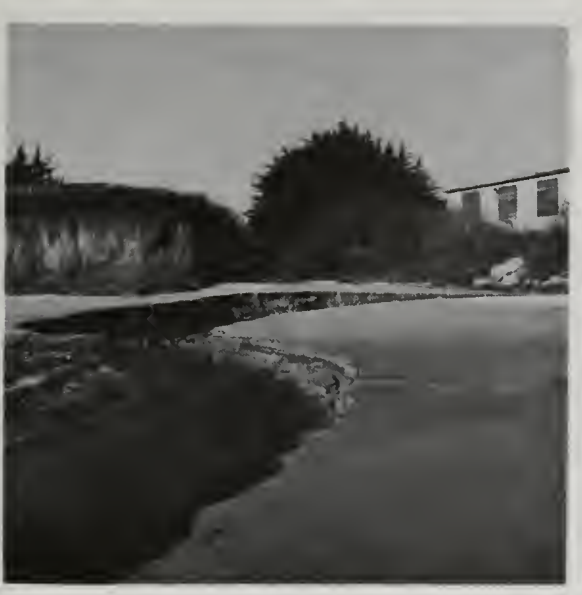

Figure 1
Mouth of Denniston Creek, Princeton, California. December 11, 1963

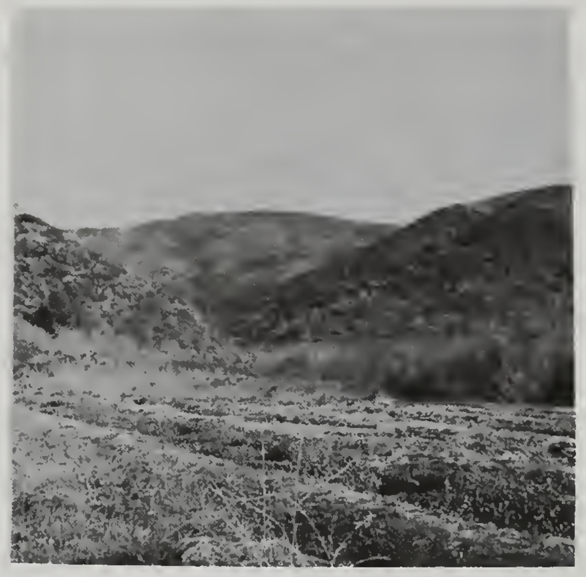

Figure 2
Brush covered hills at the upper end of Denniston Creek valley. Watercress field in foreground.
December 11, 1963

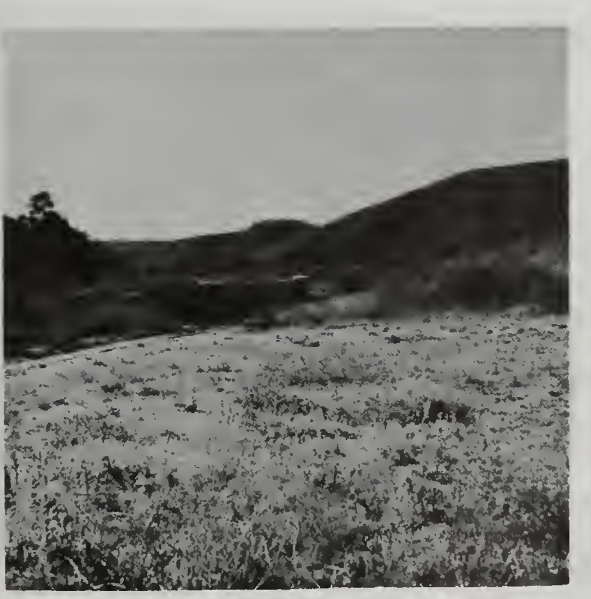

Figure 3
Brussel sprout field in Denniston Creek valley. December 11, 1963

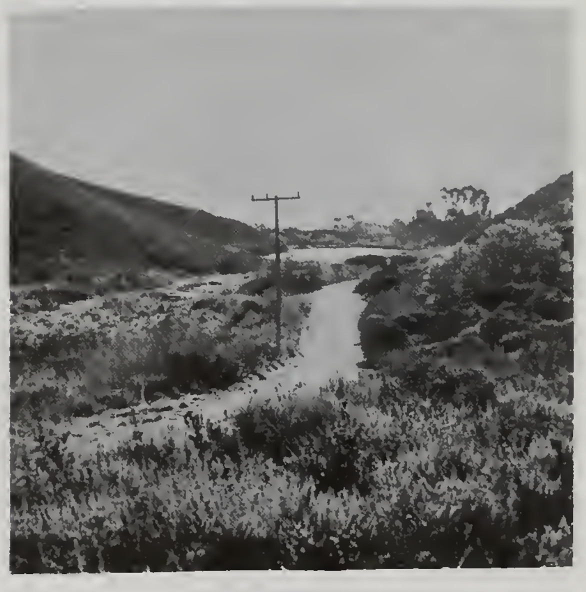

Figure 4
Denniston Creek reservoir on lower part of Denniston Creek. Downstream view from potential damsite.
December 11, 1963

valley are watered by canals from unscreened diversions of the creek (Figure 5). Irrigation water is supplied to the area along the lower stream from Denniston Reservoir at the lower end of the valley (Figure 6).

Existing Fish and Wildlife Populations

Fish

No detailed study has been made on the fish population of Denniston Creek, but it is believed to resemble that of other streams in the area, which includes trout, sculpin, and sticklebacks. All upstream movement of migratory fishes is stopped by Denniston Dam. The manager of the property reported, however, that a few fish, probably steelhead trout, attempt to get passed the dam each winter. Prior to the construction of Denniston Dam, steelhead trout and silver salmon entered the stream each year to spawn. There is a resident trout population in the area above the upstream diversion dam, which consists of rainbow and brown trout.

Wildlife

The Denniston Creek drainage supports a moderate population of wildlife, including both game and nongame species. Columbian black-tailed deer are the only big game in the area. It has been estimated that a resident population of 50 deer per square mile resides in the area. There is little seasonal movement of deer in the drainage, because of the mild climate, the pattern of movement within the area being determined by the availability of food. Upland game species are valley quail, doves, cottontail, and brush rabbits. Wild pigeons are common in the upstream timbered areas. Wild ducks and coots utilize Denniston Reservoir for resting and feeding.

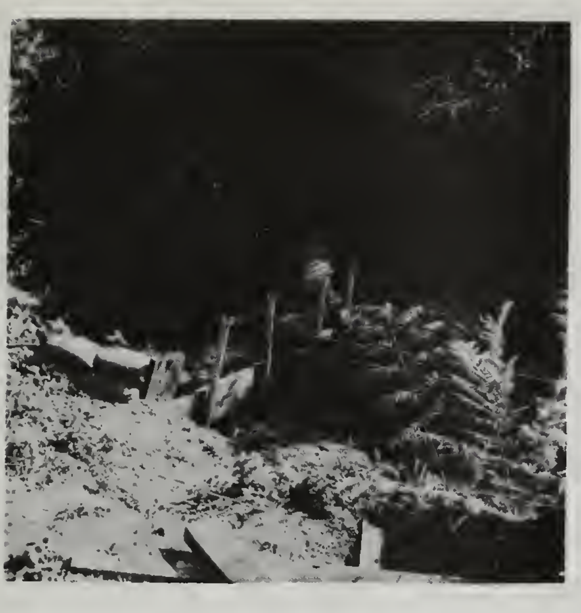

Figure 5
Agricultural diversion dam at head of Denniston Creek valley. Almost the entire flow of the stream is diverted at this point.
December 11, 1963

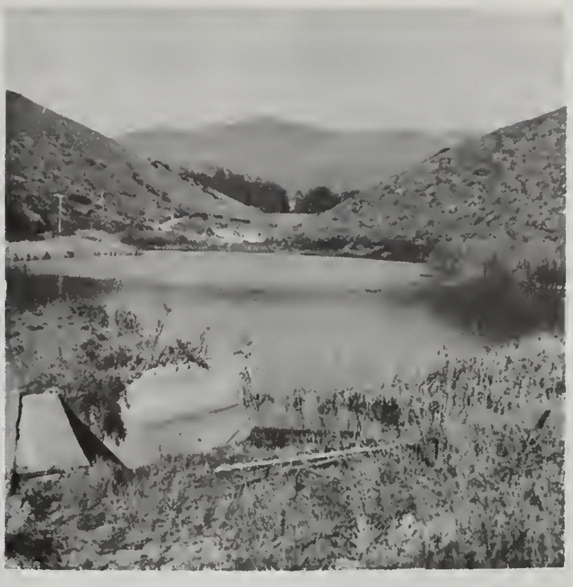

Figure 6
Upstream view of the Denniston Creek drainage from the dam spillway. Potential damsite shown in upper center of picture.
December 11, 1963

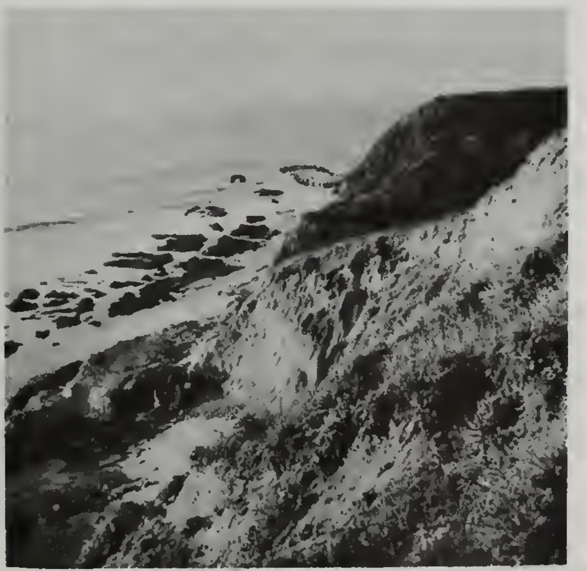

Figure 7
The falls at the mouth of Purisima Creek. December 11, 1963

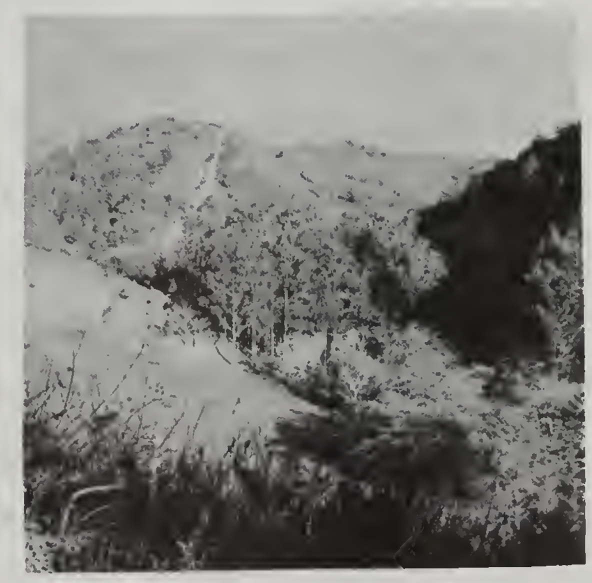

Figure 8
Upstream view from proposed Purisima Creek damsite showing lower edge of redwood forest. December 11, 1963

Resource Utilization

Presently, the fish and wildlife resources of the Denniston Creek watershed are not utilized to any great extent. The entire drainage is in private holdings and recreational access is limited. Denniston Reservoir has been planted with catchable-sized trout in the past, but planting ceased in 1954 when the property was posted against trespass because of "litterbugging" by anglers. A limited amount of shooting by nonresidents is allowed in the drainage. A shooting range, operated by a Bay Area sportsman's club, is located one-half mile above the reservoir. In addition, a private gun club leases land for hunting in the upper drainage and accounts for most of the 10 to 15 deer taken in the area each year.

Possible Effects of Future Water Development

Future water development in the Denniston Creek watershed could influence existing fish and wildlife in many ways. The extent of benefits and detriments would depend on the height and placement of a dam. A potential damsite exists at the upper end of Denniston Reservoir (Figure 6). An 80-foot dam at this spot would inundate the entire lower half of the valley and a dam 150 feet high would inundate four-fifths of the valley.

A dam at the lower end of the valley would cause the loss of excellent quail habitat (Figure 4), but should have little effec on other species of wildlife since the valley is presently cultivated, for the most part, up to the edge of the surrounding slopes. Trout would not be adversely affected by the project because the stream, through the valley section, is diverted for irrigation, and ppreciable amounts of return water do not re-enter the stream hannel until it reaches the reservoir. A reservoir in the valley ould support a self-sustaining population of warmwater game fish nd could offer good fishing if properly managed. A trout fishery, owever, would have to be maintained by stocking since there is nsufficient spawning and nursery area in the drainage to support large trout population.

It is doubtful that any real benefit would be obtained rom a water release below any project constructed at the lower nd of Denniston Creek valley. There is no fishery resource below enniston Dam at present and due to the very nature of the stream tself, it is doubtful if anything could be developed in the uture. Sufficient water presently exists in the stream bed, from eturn irrigation water and natural seepage, to fulfill the equirements of wildlife in the area.

ecommendations

(1) Public access should be provided at any future reservoir constructed on Denniston Creek.

(2) Future water developments should be managed for fishing and recreational purposes as partial compensation for the damage to wildlife brought about by project construction.

(3) A minimum pool for fish should be provided for the preservation of resident fish populations in future reservoirs in the drainage.

PURISIMA CREEK

Description of the Purisima Creek Watershed

Physical Data

Purisima Creek is located in the center of the San Mateo County coastal area (Plate C2). The creek rises at an elevation of 1,550 feet on the west slope of the Santa Cruz Mountains near the small community of Kings Mountain, and falls over a 50-foot cliff into the Pacific Ocean some five miles south of the town of Half Moon Bay (Figure 7). Purisima Creek is a spring-fed stream with a constant year-round flow that normally varies between 16 and 0.3 cubic feet per second. The stream has an average width of four feet and a depth of six inches. The stream bed is composed of gravel and boulders in the steep upper section and a mixture of gravel and sand in the lower portion.

The lower 4.3 miles of Purisima Creek is deeply entrenched in a narrow, cultivated valley surrounded by hills covered with grass and brush. The upper section changes suddenly from a valley to a moderately steep canyon clothed in a second growth redwood complex (Figure 8). The stream is shaded throughout its length by a heavy growth of willows and alders.

Land Use

The upper valley section is devoted to irrigated pasture land for beef and dairy cattle. The lower section of the valley is in cultivated fields, brussel sprouts being the primary crop. Brussel sprouts are also grown on the coastal plain at the mouth of the stream. The crops in the valley are irrigated with water pumped from pools in the stream created by splashboard dams. In addition to the dams in the lower stream that are periodically opened and closed throughout the year, the upper drainage is blocked by one 30-foot log jam and several smaller ones formed by logging debris.

Existing Fish and Wildlife Populations

Fish

Purisima Creek supports a small, self-sustaining population of rainbow and brown trout. The only other species of fish positively known to inhabit the creek is a small brook lamprey reaching a length of six inches. The stream was stocked annually with 7,000 to 40,000 steelhead between 1930 and 1939, but because of a natural barrier at the mouth, no fish returned to spawn. However, during the winter of 1938-39, local anglers fishing in the ocean at the mouth of the creek caught a number of mature steelhead, indicating that some downstream migration of the planted steelhead fingerlings did occur. An average of 7,000 rainbow trout were planted in the creek each year from 1944 to 1947. Rainbow trout catchables were planted in the lower section in 1954 and 1956.

The planting of catchable sized trout was discontinued in 1963 due to a change in the ownership of land in the middle of the planting section, which resulted in the loss of angler access. In addition to the loss of the planting area in the lower section of the stream in 1963, planting in the upstream area was precluded because of a slide that blocked the only access road.

Wildlife

The valley of Purisima Creek, being larger and more ope than Denniston Creek valley, has a larger standing population of upland game species, although the species composition is the same. The upstream drainage area of Purisima Creek is larger and more heavily forested than the Denniston Creek watershed, but the numbe of deer present are not thought to exceed 50 deer per square mile.

Resource Utilization

The present utilization of the fish and wildlife resourc of the Purisima Creek watershed is primarily limited to fishing for trout. The creek is considered to be one of the best fishing streams in the Half Moon Bay area. Fishing intensity is heavy during the first two weeks of the legal angling season, but is light for the remainder of the year. Fishing success is highest in the lower portion of the stream, following plants of catchable-sized trout. Fishing in the upstream areas is restricted by lack of access, but it produces catches of small, wild trout. Brown trout to a length of 12 inches, have been taken in the upper area, but the rainbows are small, averaging four to five inches. Additional fishing is provided by the Purisima Creek trout farm, located in t e lower end of the upstream section. This enterprise offers fishing in ponds and the owner also stocks trout in the stream along his property.

Some deer hunting takes place in the upper part of the Purisima Creek drainage. Hunting is generally confined to lands leased by two deer hunting clubs, from which 15 to 20 bucks are harvested annually.

Proposed Water Developments

The Coastside County Water District obtained water rights urisima Creek under Decision D-1064 of the State Water Rights ıd February 9, 1962. The water district has been granted the t to divert 2,750 acre-feet of water per year for municipal and cultural use. The proposed site for the project dam is in the r end of the valley in the SW$\frac{1}{4}$ of the SE$\frac{1}{2}$ of Section 2, T5S, R5W te C2).

The proposed dam, 150-feet high, would have a storage city of 4,000 acre-feet. The reservoir would have a maximum ace area of 28 acres and would be approximately 1$\frac{1}{4}$ miles long 500 feet wide. The reservoir minimum pool is expected to have pth of 20 feet and a capacity of 100 acre-feet. Water is to eleased from the dam down the natural stream channel to a rsion point located approximately two miles below the damsite one-half mile above the coast highway crossing (T6S, R5W, ion 15).

Two additional damsites on Purisima Creek are currently r investigation by the Department of Water Resources. The Lower sima site, in the SE$\frac{1}{4}$ of the SE$\frac{1}{4}$ of Section 16, T6S, R5W (Plate C2), onsidered suitable for a dam 185 feet high, with a storage city of 21,500 acre-feet. The Upper Purisima site is located he SE$\frac{1}{4}$ of the SE$\frac{1}{4}$ of Section 10,T6S, R5W. A dam 165 feet high he upper site would have a storage capacity of 13,000 acre-feet. at either of the downstream sites would back water up to the tside County Water District damsite.

Possible Effects of Future Water Development

The reservoir proposed by the Coastside County Water District would inundate all but two miles of the upper spawning and nursery area. However, the loss of the stream nursery area could be offset by the greater area made available by the reservoi itself. A small self-sustaining population of trout could maintai itself in the reservoir, since water temperatures should remain col throughout the year. The proposed dam would block all upstream access to fish below the project, but improved summer releases could compensate for this to some extent.

If fishing access is allowed at the Coastside County Watr District reservoir, natural production would have to be augmented by planted fish to maintain fishing at an acceptable level.

If either of the two lower projects were constructed, th stream fishery would be destroyed, as well as any remaining spawnig area. If trout fishing is to be maintained in the lower drainage, then the fishery would have to be managed entirely by large annual plants of artificially reared fish.

The waters of any project constructed in Purisima Creek Valley would be very fertile for the first few years after constru-tion. During the initial years of high productivity, trout would be expected to have an accelerated growth rate and produce excellet fishing. After an initial surge of productivity, however, the fertility of the impounded waters would be expected to decline and with it the quality of the fishing. A reservoir in the lower vally at a reduced rate of production, could be managed most efficiently with a self-sustaining population of warmwater game fish.

The project proposed by the Coastside County Water District old be expected to have little harmful effect on the resident idlife, since a large portion of the proposed reservoir basin will elocated within a steep-sided canyon. The reservoir could offer oe mitigation for the loss of wildlife habitat by providing a eting area for migratory water fowl. The downstream area should c be adversely affected by the project providing no vegetation is eoved from the stream banks. The valley section of the stream cld be enhanced to some extent by the larger flows of water eased from the reservoir during the summer months.

Water project development in the lower end of Purisima ek Valley would destroy a considerable amount of small game itat. The most important loss would be the reduction of the il population in the area. Quail coveys presently utilizing the ed and cover on the valley floor could not be supported adequately the surrounding hills.

Recommendations

(1) It is recommended the permittee shall maintain a w of 1.0 cubic foot per second in Purisima Creek between the rage dam (T6S, R5W, Section 2) and the point of rediversion ing the period from November 1 of each year to May 1 of the ceeding year and shall bypass the natural flow of the stream the storage dam from May 2 to October 31 of each year for the ntenance of fish life.

(2) The diversion intake on Purisima Creek (T6S, R5W, tion 15) should be adequately screened to prevent loss of fish fe.

(3) It is recommended that a minimum pool of 100 acre-feet be established for maintenance of fish life.

(4) It is recommended that the public be granted access to the reservoir for fishing and recreational purposes. This will provide partial compensation for damage resulting to the fishery resource.

The two lower projects on Purisima Creek would destroy the remaining stream habitat. There would be a few miles of stream left below the middle site but greater fishery benefits could be obtained by leaving a larger minimum pool in the reservoir than by making a significant downstream release. If either of the lower projects are built, it is recommended that a minimum pool be maintained to preserve fish life. A minimum of 4,000 acre-feet of storage should be maintained in a reservoir at the lower site and a minimum of 2,500 acre-feet should be maintained at the middle site. A large minimum pool in these reservoirs could offset some of the damage done to fishery resources in the lower drainage.

PESCADERO CREEK

Description of the Pescadero Creek Watershed

hysical Data

The Pescadero Creek drainage is located in the southern nd of San Mateo County (Plate C3), with a small portion of the upper atershed lying within the boundaries of Santa Cruz County. The rainage is bounded on the north by Alpine Road, on the south by tate Highway 9, and on the southwest by Butano Ridge. Pescadero reek originates at an elevation of 2,800 feet in the Santa Cruz ountains and enters the ocean two miles northwest of the town of escadero. Principal tributaries of Pescadero Creek, starting at he upstream end of the drainage, are Oil, Slate, and Peters creeks. he upper drainage is in relatively rugged, heavily timbered mounains and about 30,000 acres of the total 39,000 acres in the rainage are wooded. The lowlands of the drainage are composed of ently rolling hills and benchlands devoted to agriculture Figures 9 and 10).

The total length of the main stem of Pescadero Creek is pproximately 26 miles. The stream bed in the upper reaches of he drainage is composed primarily of gravel while a mixture of ravel and boulders is more common in the middle section. The tream bed in the lower stretches of the stream is composed of mixture of sand and gravel, where the water velocity lessens. ll of the upper and middle portions of the drainage are considered o be good spawning areas for salmonids.

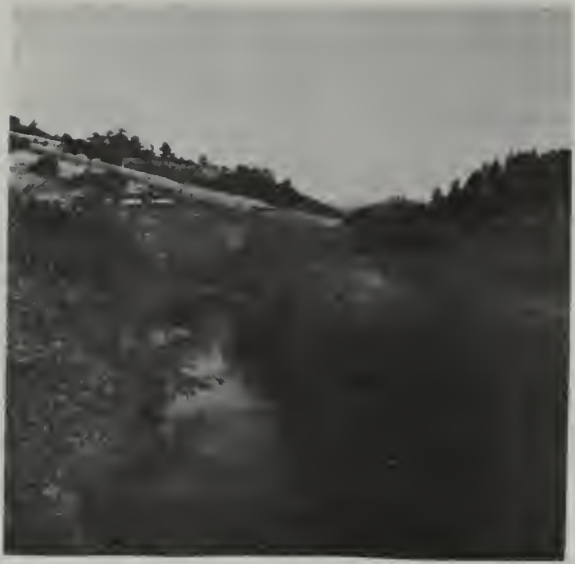

Figure 9
Cultivated fields bordering Pescadero Creek in the area proposed for channel improvement. December 12, 1963

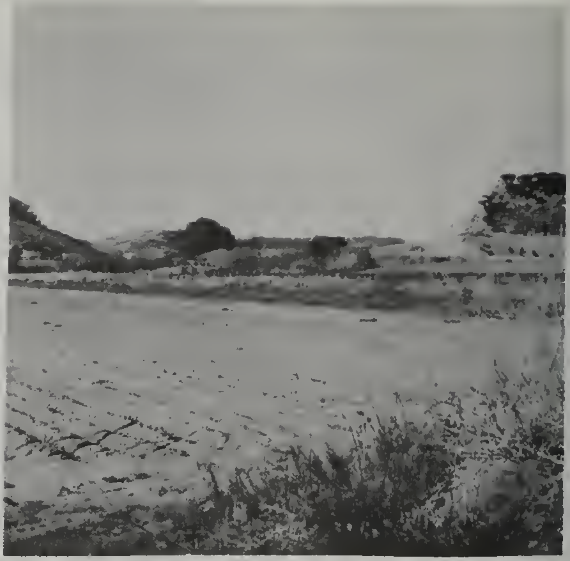

Figure 10
Cultivated fields just east of the town of Pescadero.
December 12, 1963

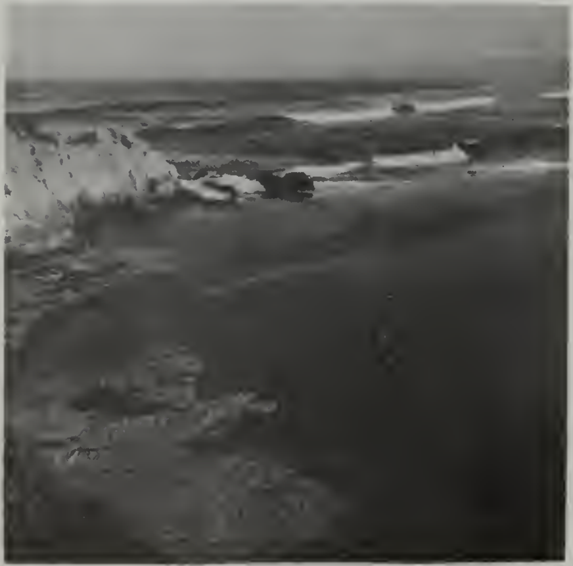

Figure 11
Mouth of Pescadero Creek showing high tide washing over the bar.
December 12, 1963

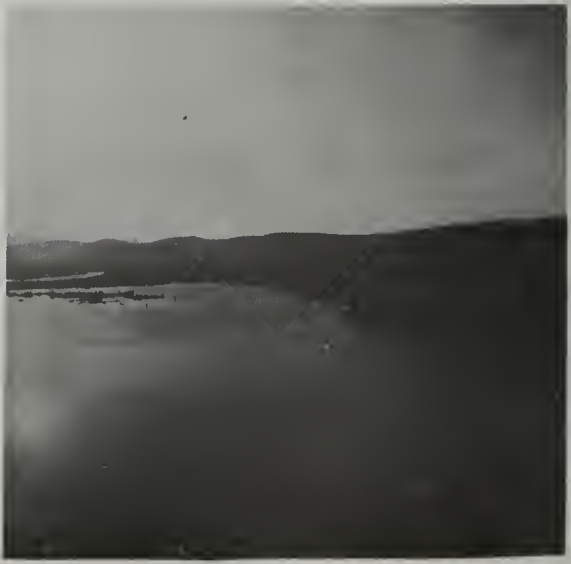

Figure 12
Upstream view of Pescadero Creek lagoon from Highway 1 bridge
December 12, 1963

Several splashboard dams in the upper and middle drainage are used to back up small amounts of water for swimming during the summer. Many of these dams have been washed out periodically by flood flows during winter storms. There is a permanent dam at Loma Mar that has a good ladder for fish passage. Near the mouth of Pescadero Creek, local farmers install a high flashboard dam each summer to divert water for irrigation and for salinity repulsion.

The mouth of Pescadero Creek is closed by a sand bar during much of the year, forming a brackish-water lagoon that extends upstream some distance (Figures 11 and 12). The bar opens only when the stream flow is high enough to top the bar and cut its way through, or when mechanical means are used. Heavy wave action, where the stream enters the ocean, often closes the stream mouth as soon as it opens.

Land Use

The economy of the Pescadero area is dependent on agricultural produce grown in the lower end of the valley and on the surrounding coastal plain. The primary crops are artichokes and brussel sprouts, which are well adapted to the coastal climate. Orchards and cultivated fields extend upstream as far as Loma Mar and, in addition, considerable grazing is carried on in the area. Much logging takes place in the upper drainage and this has led to the siltation of a considerable portion of the upper spawning area.

Existing Fish and Wildlife Populations

Fish

Pescadero Creek maintains runs of steelhead trout and silver salmon. The steelhead run is estimated to be approximately 1,500 fish each year. It is not presently known how many silver salmon utilize the drainage for spawning, but the numbers are probably small when compared with steelhead. This stream had an excellent run of silver salmon in past years and barrels of salt salmon were put up each year by the residents of the area. The erratic opening and closing of the stream mouth may possibly have a deleterious affect on the steelhead and the silver salmon runs.

Other species of fish found in the Pescadero Creek drainage include sticklebacks and sculpins. Starry flounders have been caught by anglers in the lagoon and in the lower stream a short distance above the lagoon, but these fish are not permanent residents.

Wildlife

The Pescadero Creek drainage supports a variety of wildlife, which includes populations of deer, valley quail, band-tailed pigeons and various fur-bearing mammals. In February 1963, French redlegged partridges were released in the Pescadero area and are apparently spreading out in the drainage. Waterfowl are found in the delta region at the mouth of the creek at certain times of the year. Population estimates are not available for most of the game species in the area, except for deer, which are estimated to have a density of approximately 75 animals per square mile.

Resource Utilization

Pescadero Creek is not only the largest stream in San Mateo County, but it is also the most important fishing stream in the area, second only to the San Lorenzo River in Santa Cruz County. Portola State Park and San Mateo County Memorial Park are located within the upper drainage while San Mateo Beaches State Park is located at the mouth of the stream. Many private and semiprivate camps are also scattered throughout the watershed. In addition to the group recreation areas, there are many summer homes along the stream.

Pescadero Creek, owing to its close proximity to the San Francisco Bay Area and the recreational developments along its banks, supports heavy fishing pressure. It has been estimated that approximately 100,000 recreation man-days are expended within the boundaries of Portola State Park alone. To augment the natural production of the stream, the California Department of Fish and Game plants an average of 40,000 catchable trout each season. The area of stocking is from Memorial Park upstream to Portola State Park.

During the 1954-55 season, a winter creel census revealed that approximately 2,500 angler-days were expended fishing for adult steelhead in Pescadero Creek (Figure 13). All of the angling took place within two miles of the mouth of the stream, since the established upstream limit of winter fishing is the bridge at the town of Pescadero. The Pescadero Creek watershed, with the exception of the parks is in private ownership. Fishing, however, is not restricted except in a few isolated areas.

Most of the Pescadero Creek drainage is posted against hunting, but a considerable amount of hunting takes place on land leased by four gun clubs. Three clubs are located in the upstrea area and one operates in the delta area near the town of Pescader The deer kill in the drainage is between 30 and 50 bucks per year most of which are taken in the headwater area. The Rolling Hills Gun Club, which has holdings in the lower drainage, takes a few deer each season, but the club also releases pen-reared pheasants on their land and operates duck blinds in the delta area.

Proposed Water Developments

The County of San Mateo is presently engaged in the stu of a water conservation and flood control project on Pescadero Creek. The consulting firm of George S. Nolte was retained to develop a plan for the drainage. A report on the possibilities of constructing and financing a project on Pescadero Creek was submitted to the County Board of Supervisors on April 18, 1963. The consultant proposed that a project be constructed at Worley Flat, between Memorial Park and Portola State Park, and suggested planning assistance be requested from the State Soil Conservation Commission under Public Law 566. Subsequently, Application SWS No. 59 was filed with the State Soil Conservation Commission on October 30, 1963, for assistance in planning a Pescadero Creek project.

The proposed project would be located at Worley Flat in the NE$\frac{1}{4}$ of the NE$\frac{1}{4}$ of Section 2, T8S, R5W (Plate C3). The proposed dam would be of the earth-fill type with a crest elevation of 400 feet, approximately 190 feet above the stream bed. The project would have a storage capacity of 25,000 acre-feet of water and a surface area of 400 acres. The project would develop a firm yield of 11,500 acre-feet of water, 6,000 acre-feet for irrigation, and 5,200 acre-feet for municipal and industrial use. A minimum pool of 5,000 acre-feet with a surface area of 150 acres has been proposed for recreation and fishery maintenance. Water developed by the project would be conveyed down the natural stream channel to a point just above the town of Pescadero, where it would be diverted by a concrete dam for domestic and agricultural consumption. Flood control would be accomplished by the widening of 6,000 to 8,000 feet of the lower creek channel to accommodate peak flows of 7,000 cubic feet per second (Figure 9). It has been proposed that all channel improvement work be done on the right or north bank to preserve the natural vegetation and shade that now exists on the south side of the channel.

Two additional damsites below the proposed Worley Flats Project are currently being studied by the California Department of Water Resources. One site is located below Loma Mar in the NW$\frac{1}{4}$ of the SW$\frac{1}{4}$ of Section 4, T8S, R4W, and the other is located in the NW$\frac{1}{4}$ of the SW$\frac{1}{4}$ of Section 12, T8S, R5W, (Plate C3).

A dam 190 feet high at the site near Loma Mar would impound 75,000 acre-feet and would back water up to the same point reached by the Worley Flats Project. The Loma Mar site is an alternate to the Worley Flats site and only one of the two would ultimately be developed.

The lower dam, listed in Department of Water Resources' Bulletin 3, "The California Water Plan," would be 120 feet high and would impound 28,000 acre-feet. This dam would back water up to the Worley Flats site.

Possible Effects of Future Water Development

A dam at Worley Flat would block access for salmon and steelhead to approximately 18 miles of spawning area. The reservoir would also inundate nine miles of the remaining spawnin and nursery area above the dam. Upon completion of the project, an estimated four miles of spawning and nursery area would remain downstream.

The proposed diversion dam near the town of Pescadero would block the upstream migration of adult salmon and steelhead, unless the proper fish passage facilities were installed and maintained. In addition to the possible delay of upstream migrating fish that might be caused by the project's diversion dam, the fish may not be able to enter the stream at all unless the proper releases of water were made to open the bar at the creek mouth.

Increased summer flows in Pescadero Creek would be a benefit to the stream and could potentially increase the carrying capacity for both trout and salmon. The project could conceivably increase the productivity of the downstream spawning area also by controlling winter stream flows. It is not believed the productivity would be increased sufficiently, however, to replace the spawning area inundated or cut off by the reservoir.

The proposed reservoir would inundate a minimum of 400 acres of game habitat and thereby reduce the game carrying capacity of the watershed by a like proportion. Channelization of the lower reaches of the stream could affect game populations by reducing riparian habitat along the stream banks. Flood protection offered by the project could materially affect the marsh area at the mouth of Pescadero Creek by allowing more of the area to be reclaimed for farming.

A dam 190 feet high at the Loma Mar site would have many far-reaching effects on the area. The project would not only destroy an additional four miles of highly productive trout stream but it would inundate Loma Mar, the presently utilized area of San Mateo County Memorial Park, the Oakland YMCA Camp, and most of the summer home sites in the area.

The Loma Mar Project would treble the size of the proposed Worley Flat development and would offer a greatly increased lake fishing area. The larger reservoir could be expected to offer more fishing than the inundated river area but the cost of management would be higher. The reservoir would offer a different type of fishing than was formerly available. Where formerly the anglers were able to wade and fish the stream successfully, the steep terrain around the reservoir and the broad expanse of water would necessitate the use of boats for the best fishing. Several miles of stream would still remain below the project, however, and a reduced stream fishery could be maintained.

A large project constructed at the Loma Mar site would inundate a minimum of one thousand acres of game habitat. All of the productive river bottom and adjacent beach lands would be inundated in the project area and game would be forced upon the surrounding steep slopes that could support few, if any, of the displaced birds and mammals.

A low level project constructed at the lower site would destroy all of the remaining trout habitat below Worley Flat. A shallow reservoir in this more open location would not be expected to provide good year-round trout habitat, but it should be suitable for warmwater fish.

A reservoir at the lower end of the drainage would not inundate as much deer habitat as the Loma Mar project but it would be very detrimental to quail and small game animals.

Recommendations

Fishery Mitigation

Preliminary recommendations made by the Department of Fish and Game for the Worley Flat Project called for trapping and transporting adult salmon and steelhead around the project for upstream release. This procedure would be satisfactory during the construction period, but should not be considered after project completion for the following reasons:

(1) The reservoir, when filled, would inundate approximately one-half of the remaining spawning area left above the damsite.

(2) Fry and spawned-out adults would be trapped behind the dam with no means of excape except over the spillway during intermittent spills. In all likelihood, the steelhead trapped behind the dam would enter the summer trout catch in large

numbers which would further reduce their chance of migrating to sea.

(3) The cost of trapping and transporting the fish would probably be greater than the return that could be expected from the operation.

It is recommended, therefore, that the following plan of management be followed for Pescadero Creek if and when the presently envisioned Worley Flat Project is completed:

(1) Construct a hatchery below the dam for maintenance of the steelhead trout and silver salmon runs.

(2) Construct a combination of fish-barrier type of dam and ladder for the downstream diversion structure so the most efficient passage of migrating fish may be obtained.

(3) Properly screen all diversions from the project to reduce fish loss.

(4) Water should be reserved in the reservoir for downstream release throughout the year for fishery maintenance. The releases should be sufficient to reach the ocean. Winter and spring releases should be adjusted to allow for periodic flushing flows to open the stream mouth.

Suggested release schedule:

(a) November 1 through March 30 for attraction, transportation, and spawning flows	3,200 acre-feet
(b) April 1 through June 30 for downstream migration of juvenile silver salmon and steelhead.	1,500 acre-feet

(c) July 1 through October 31 for nursery flows . . . . 700 acre-feet

The justification for a hatchery as an adjunct to the Worley Flat project is based on the calculation that four-fifths of the spawning and nursery area will be lost to anadromous fish production upon completion of the project. As mitigation for the loss of the upstream area, artificial propagation must be employed to perpetuate the run. A loss of four-fifths of the steelhead run would seriously affect the present popular winter fishery.

The area immediately below the dam should be an ideal location for a hatchery providing the project water is of the proper temperature and quality. The hatchery would be a nonconsumptive user of water, so special releases would be unnecessary for operation of the facility. However, winter flushing releases of an as yet undetermined magnitude would be needed to periodically breach the bar at the stream mouth and to provide a transportation flow to the upstream areas.

The propagation facility should be large enough to hatch and rear 60,000 steelhead trout and silver salmon to yearling size in order to guarantee perpetuation of the fishery.

Both of the lower Pescadero Creek projects would destroy or block access to the remaining trout and salmon spawning and nursery areas. In order to maintain the steelhead and silver salmon runs in the stream, the entire run would have to be artificially propagated. It is anticipated that water suitable for hatchery operation would be available below the Loma Mar Project, but the water below the lower project would probably be too warm.

Specific recommendations for the Loma Mar Project, in addition to the provisions made for the Worley Flat development, are as follows:

(1) A minimum pool of 15,000 acre-feet be maintained for the maintenance of fish life and to insure a proper water supply for a hatchery.

(2) Construct a hatchery below the project to hatch and rear 70,000 yearling steelhead trout and silver salmon to compensate for the loss of spawning and nursery areas.

Recommendations for the lower Pescadero Creek project depend on the project operation plan. In general the recommendations for the project are the same as for the upstream developments with the following exceptions:

(1) Conduct a study to determine the suitability of project water for a steelhead hatchery.

(2) If a water quality study shows the project water to be unsuitable for hatchery operation, then an egg taking facility must be constructed below the project. Eggs from the installation must be transported to a suitable area for hatching and the fry reared to yearling size for replanting in the stream, the cost of propagation to be borne by the developer.

Fishery Enhancement

There is an excellent opportunity for the Pescadero Creek fishery to be enhanced by proper management. The steelhead runs have been able to hold their own through recent years even though subject to heavy fishing pressure and unscreened irrigation diversions. Silver salmon runs into the stream on the other hand, have declined drastically, possibly from a combination of overfishing and dry years when the stream mouth opened too late for them to spawn.

If a hatchery were built at Worley Flat or another area in the drainage to mitigate the loss of steelhead spawning grounds it would then be possible to enlarge the basic facility to propagate an additional 50,000 silver salmon at a fraction of the original cost. Pescadero Creek, although small when compared to many streams north of the "Golden Gate," is classified as one of the 15 most productive steelhead streams in Northern California. The popularity of this stream could be greatly increased by rebuilding the native silver salmon run to its former level. The State of Washington has had excellent success in restoring the steelhead and silver salmon runs in the streams of the heavily fished Seattle area. Water development, logging, and heavy fishing depleted the runs in that area, but by the use of modern management techniques in their hatcheries, and by planting yearling fish, many of the runs were restored to their former abundance.

In addition to bolstering the winter fishery in Pescadero Creek with hatchery management, additional enhancement may be gained by rearing catchable trout for the drainage at the same facility. Presently 40,000 catchable trout, reared in other areas, are planted in the creek each season. The creation of a reservoir on this popular stream could be expected to cause an increase in the number of people coming to the area, with a resultant increase in fishing pressure. The added demand for catchable trout might well make it economically feasible to rear he fish in the local facility if the proper water temperatures ould be obtained for accelerated growth.

ildlife Mitigation

The wildlife produced on the land to be covered by the roposed reservoirs cannot be supported in the immediate area. he surrounding land is now carrying the maximum populations that t can sustain. The marsh in the Pescadero-Butano Delta area hould be acquired and placed under public control as partial itigation for the loss of habitat in upstream areas and to afeguard the natural beauty of the marsh from local land use hanges. This area could be managed as a wildlife refuge and t would furnish habitat for not only game birds and animals but any nongame species as well. The addition of a wildlife refuge n the heavily utilized Coastal San Mateo County area would not nly preserve rapidly dwindling natural marsh habitat, but it ould provide suitable nesting and breeding grounds for a host of ildlife species.

These recommendations for fish and wildlife mitigation nd enhancement features for the proposed Pescadero Creek Projects re out of necessity brief. More of the project's operational eatures must be known in order for more specific recommendations o be made. However, in light of present knowledge, the anagement recommendations made in this report are considered to e the minimum requirements necessary to maintain the present fish nd wildlife values of the drainage.

GAZOS CREEK

Description of the Gazos Creek Watershed

Physical Data

Gazos Creek rises at an elevation of 2,080 feet near the northwest corner of Big Basin Redwoods State Park and approximately one-fourth mile inside the Santa Cruz County line (Plate C4). The main stream runs in a southwesterly direction for nearly nine miles entering the Pacific Ocean two and one-half miles south of the Pigeon Point Lighthouse (Figure 14).

There are an estimated 25 miles of stream within the drainage but only two tributaries, the South Fork and Old Womans Creek, are worthy of mention. Gazos Creek flows generally through a narrow, winding canyon through most of its length. The upper stream channel is relatively steep with few pools present. The gradient of the stream diminishes below the South Fork with pools becoming more common downstream. Despite the logging debris and considerable silt from road construction, there is a fair amount of spawning gravel scattered along the stream. The mouth of Gazos Creek is open most of the year due to a steady stream flow.

The forest cover throughout the drainage is fairly heavy and consists of a second growth fir-redwood complex. The stream channel is heavily shaded throughout most of its length by alders and willows (Figure 15).

Land Use

The entire drainage is composed of private holdings, with the land being managed primarily for sustained yield timber

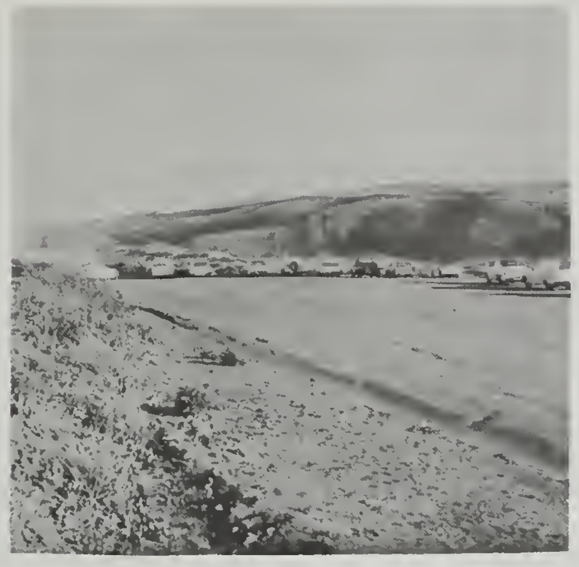

Figure 13
Steelhead fishermen's cars parked at the mouth of Pescadero Creek.
December 12, 1963

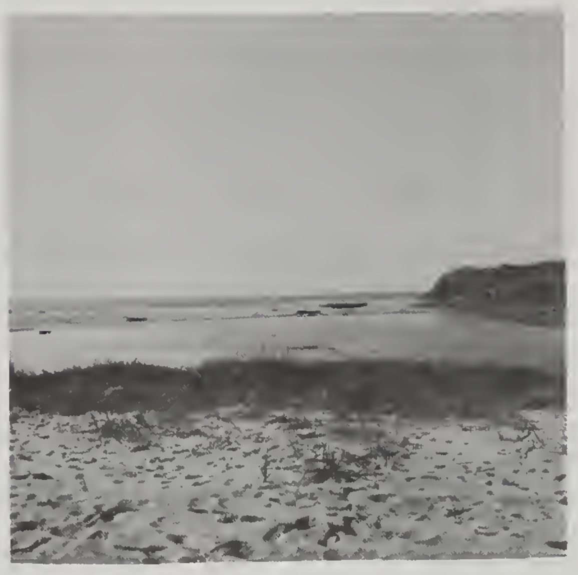

Figure 14
Gazos Creek lagoon with ocean in the background.
December 12, 1963

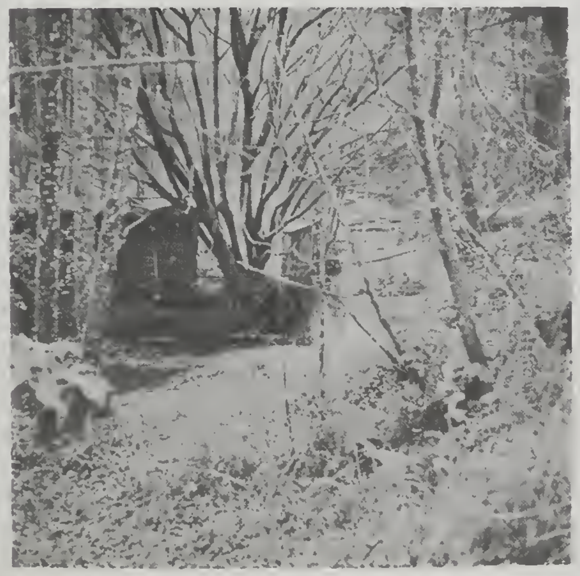

Figure 15
Old logging dam on lower Gazos Creek.
December 12, 1963

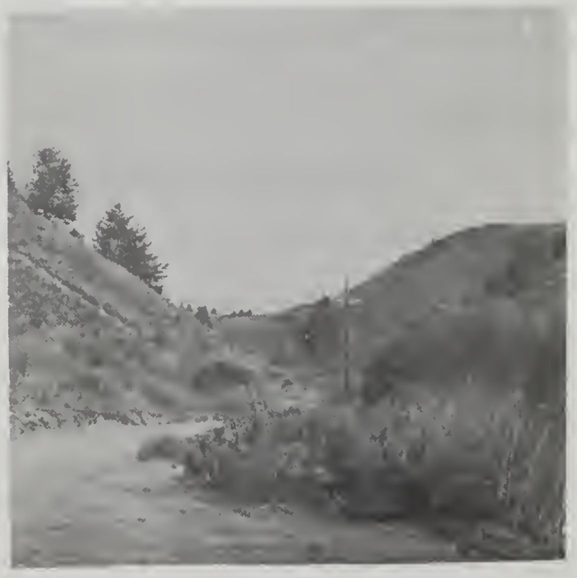

Figure 16
Upstream view of potential damsite on lower Gazos Creek. Typical quail cover in foreground.
December 12, 1963

production. Two splashboard dams near the creek mouth form pools for pump diversions. The uppermost diversion is owned by the Campbell Soup Company mushroom farm on the coastal plain north of the creek. Water is pumped from the lower diversion to irrigate land lying south of the creek.

Existing Fish and Wildlife Populations

Fish

Species of fish known to inhabit Gazos Creek are steelhead trout, silver salmon, and one or more species of sculpin. The creek is a typical, small, coastal steelhead stream. The shaded, spring-fed waters of the stream offer suitable egg incubation and nursery conditions for steelhead and silver salmon throughout the year. It has been estimated that Gazos Creek presently has an annual run of approximately 100 steelhead. Silver salmon have been observed in the stream periodically, but there is no evidence to indicate that a run of any consequence spawns in the drainage.

Wildlife

Deer are common throughout the drainage, and a resident population of 75 deer per square mile is estimated to range there. Sustained yield logging, producing excellent forage and cover conditions, coupled with an excellent water supply, make the area ideal deer habitat. Valley quail are more common in the lower end of the drainage where the heavy timber gives way to rolling grass and brush-covered hillsides (Figure 16). The Gazos Creek watershed also supports populations of band-tailed pigeons and various small fur-bearing mammals.

Resource Utilization

Gazos Creek is a popular summer trout fishing stream, receiving heavy use for a stream of its size. During the summer fishing season, as many as 100 individual fishing camps have been counted along the creek at one time. The trout fishery is supported mainly by plants of catchable-sized trout, with young steelhead making up the balance of the catch. All of the drainage is in private ownership, but practically unrestricted fishing access is allowed. Winter steelhead angling is restricted to the tidewater portion of the stream, which permits only a small portion of the creek to be fished.

Although almost unrestricted access is allowed for summer fishing along Gazos Creek, hunting access is severely limited in the surrounding drainage because of fire closures in the private timber holdings. Two hunting clubs lease land within the drainage, however, and probably account for a majority of the 10 to 15 deer killed in the area each season.

Possible Effects of Future Water Development

Gazos Creek, along with several other streams in the immediate area, is presently under consideration for water development by the State Division of Soil Conservation and the State Department of Water Resources. One potential damsite is located approximately one mile above the stream mouth. A dam 180 feet high, at the lower end of the stream, would inundate four miles of the most productive fish habitat and would destroy the anadromous fish runs. If a trout fishery of any magnitude were to be established in a reservoir on this stream, it would be almost entirely dependent upon planted fish, since there would be insufficient spawning are available to support a large self-supporting population.

At the present time, the general consensus is that the drainages lying to the north of Gazos Creek would be developed prior to water development on this stream. If the Pescadero Creek Project were constructed first, and a fish hatchery were construct as an adjunct to the project, it would then be possible to enlarge the facility to care for the run presently spawning in Gazos Creek A hatchery small enough to care for the Gazos Creek run would be uneconomical to operate. To mitigate for the loss of spawning an nursery areas it would, however, be feasible to trap the adults and take the eggs to another facility for hatching and rearing. After rearing, it would then be possible to plant the progeny of the run back in the stream in order for them to repeat their life cycle. In this manner, the Gazos Creek run would not be lost and even more steelhead angling could be produced by opening a longer stretch of the stream to winter fishing. Winter fishing could als be improved below a project on this stream if holding pools were dredged in the stream bed and good steady releases of water were made during the fishing season.

If a water project was built at the lower end of the Gazos Creek drainage, it would destroy a considerable amount of quail habitat. The creek bottom area is also utilized to some extent by deer, especially does and fawns. It would be difficult to mitigate wildlife losses in this drainage because of the narrow crooked valley through which the stream flows and because of the steep nature of the surrounding terrain.

ecommendations

If the presently envisioned project is constructed near e mouth of Gazos Creek the following recommendations are roposed:

(1) Construct a fish trapping and egg taking facility elow the dam for the maintenance of the existing steelhead and ilver salmon runs.

(2) Hatch the eggs taken on Gazos Creek at another acility but rear the fingerlings for replanting in the stream.

(3) As partial mitigation for the loss of fish and ildlife habitat in the drainage provide public access and manage e reservoir for fishing and recreation.

(4) Provide an adequate minimum pool in the reservoir insure perpetuation of the resident fish populations.

(5) Provide adequate downstream releases from the roject during the period from October 1 to May 31 to open the ar at the stream mouth and for transportation flows for migrating ish.

(6) Move the existing winter fishing boundary upstream a point 250 feet below the proposed egg taking station to allow nglers a greater fishing area.

SUMMARY

A survey of the fish and wildlife populations of Denniston, Purisima, Pescadero, and Gazos creeks has shown that self-sustaining populations of resident species are present in these drainages. Pescadero and Gazos creeks in the southern end of the county were found to have not only the largest fish and wildlife populations but the resource was better utilized.

Denniston and Purisima creeks would be damaged less by water development within their drainages than the other two streams under study. On the contrary, these two streams could be enhanced to some degree by water projects. Neither Denniston or Purisima Creek has an anadromous fish run. The resident populations are not large and the fish never attain large size because of their restricted environment and limited food supply. Poor access into these two drainages reduces utilization of both fish and game resources.

Some wildlife habitat would be inundated by any project constructed in either Denniston or Purisima Creek and it could not be replaced. However, new water habitat would be created that could be of some benefit to waterfowl.

Some degree of enhancement could be afforded these streams if the reservoirs created by future projects would be opened to fishing. Ample summer releases below the proposed Coastside County Water District project on Purisima Creek could improve stream conditions in the valley and offer some enhancement if riparian habitat were left unaltered.

Pescadero Creek is the most important stream in the coastal area of San Mateo. The creek supports a resident and anadromous trout (steelhead) population and a silver salmon run. An abundant deer population is present in the watershed along with fair numbers of quail and other upland game species. In addition to the abundance of wildlife in the drainage, Pescadero Creek also has the greatest potential for water development because of its large watershed.

The Pescadero Creek drainage is an important source of recreation for the Bay Area communities, and fishing constitutes one of the major recreational outlets. Any agency planning a water project in this drainage should explore every means of developing the full fishery potential.

Construction of a dam at any one of three sites on Pescadero Creek, large enough to fulfill the area's future water requirements, would necessitate artificial propagation to maintain the stream's steelhead trout and silver salmon runs. Any fairly large dam on this stream would inundate most of the present spawning and nursery grounds and would block access to all remaining upstream areas.

If the proposed Worley Flat project or one of a similar size is constructed on Pescadero Creek, then it is recommended that a hatchery be constructed as mitigation for the loss of spawning area. The hatchery should be large enough to hatch and rear a total of 60,000 steelhead and silver salmon yearlings annually to guarantee perpetration of the runs. In view of possible future water development on San Mateo County coastal streams, the basic hatchery facility could be designed for future expansion to accommodate additional fish.

The downstream diversion structure for Pescadero Creek water should be designed as a fish barrier as well as a diversion dam. To insure the most efficient use of a fish ladder, the accompanying barrier must be designed to guide the fish to the ladder entrance. The project's diversion structure must also be well screened to avoid loss of migrant fish.

Maintenance releases below the project's diversion dam must be large enough, during the winter and spring months, to allow the bar at the stream mouth to be breached for the passage of upstream and downstream migrants.

As compensation for the loss of wildlife habitat in the reservoir, it is recommended that the marsh at the mouth of the stream be purchased for waterfowl habitat.

Possible enhancement features for the Worley Flat project include enlargement of the proposed hatchery to accommodate a larger steelhead and silver salmon run, and to provide for the rearing of catchable trout to be planted in the reservoir and upper watershed.

Water development in the Gazos Creek watershed could be detrimental to both anadromous fish and wildlife if a dam were constructed in the lower end of the drainage. A reservoir within the lower six miles of the drainage would destroy most of the silver salmon and steelhead spawning area and inundate valuable wildlife habitat. The anadromous fish could be trapped and their eggs propagated elsewhere, but the wildlife driven out of the inundated area by water could not be easily compensated for.

The coastal portion of San Mateo County has many small streams not included in this study, the most important of which are Pilarcitos, San Gregorio, and Whitehouse creeks. These three streams support small runs of steelhead as do most of the California coastal streams north of Point Arguello that do not have permanent barriers at their mouths. The majority of the small streams, however, do not have consistant runs as the sand bars at their mouths are not breached each year.

The wildlife species composition in the drainages not included in the study are for all practical purposes considered to be the same as the streams under investigation. The abundance of wildlife in each drainage being governed by the size of the watershed, the type of vegetative cover present, and the local land use practices.

The recommendations for the maintenance and enhancement of fish and wildlife included in this report are preliminary in nature and are not intended as a final solution to the problems discussed. They do, however, suggest methods by which the natural resources can be protected. In the event feasibility level studies are conducted on streams in the area at some later date, sufficient funds should then be allocated to complete the fish and wildlife studies at a corresponding level.

BIBLIOGRAPHY

Anonymous, "Preliminary Investigation of Alternative Water Sources for Coastside County Water District." Kennedy Engineers, San Francisco, California; 11 pages, 3 tables. 1962.

Anonymous, "Pescadero Creek Report Prepared for County of San Mateo." George S. Nolte, Consulting Civil Engineers, Inc., Palo Alto, California; 27 pages, 2 tables, 7 figures, 4 appendices. 1963.

Shapovalov, Leo and Taft, Alan C., "The Life Histories of the Steelhead Rainbow Trout (Salmo Gairdneri Gairdneri) and Silver Salmon (Oncorhynchus Kisutch): With Special Reference to Waddell Creek, California, and Recommendations Regarding Their Management." State of California Department of Fish and Game, Fish Bulletin No. 98, 1954; 375 pages, 32 figures. 1954.

APPENDIX D

RECREATION PLANNING STUDIES

APPENDIX D

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etter of Transmittal, dated May 4, 1964; Subject: "A Recreation Reconnaissance of 14 Potential Reservoir Sites" and "A Study of Potential Area-Wide Reservoir Associated Recreation Demand and Data for Compilation of Unit Benefit" 230

A Recreation Reconnaissance of 14 Potential Reservoir Sites" and "A Study of Potential Area-Wide Reservoir Associated Recreation Demand and Data for Compilation of Unit Benefit" 233

etter of Transmittal, dated June 11, 1964: Subject: "Studies of Recreation Land Use, Potential Recreation Use and Estimated Recreation Costs for Denniston, Lower Purisima, Worley Flat, and Pigeon Point Projects" 268

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PLATES

THE PLATES FOR APPENDIX D (PLATES D1 through D5) ARE BOUND AT THE END OF THE BULLETIN FOLLOWING PLATE C4.

State of California **The Resources Agency of C**

Memorandum

To : Honorable William E. Warne, Director
Department of Water Resources

Attention: Mr. Charles McCullough, Chief
Bay Area Branch

Date :May 4, 1964

Subject :Transmittal of R
A Recreation Reconnais
of 14 Potential Reser
Sites - Coastal San M
County Investigation

From : **Department of Parks and Recreation**

Two copies of the attached subject report are transmitted herewit as partial fulfillment of Interagency Agreement No. 252781, where Parks performs recreation planning for Water Resources. The report was prepared at the request of Mr. Charles A. McCullough, Chief, Bay Area Branch, and constitutes the first half of the wor to be accomplished for the Coastal San Mateo County Investigation It is understood that our report on those reservoirs chosen for final consideration will be submitted before the close of this fiscal year.

The subject report evaluates the recreation potential of some fourteen tentative reservoir sites in the coastal portion of San Mateo County. It presents this evaluation from the economic standpoint in order to meet the needs of your department in its project formulation studies. However, the report does not attempt to evaluate the possible esthetic and operational affects several of the proposed reservoirs could have on existing or planned future units of the State Park System and the existing San Mateo County Memorial Park. The following comments and recommendations will present the views of the Department of Parks and Recreation upon the propriety and desirability of constructi several of the reservoirs now under study:

Worley Flat Reservoir

Worley Flat reservoir would inundate a sizeable portion of the existing Portola State Park, if constructed to an elevation of 440 feet. Even if constructed to an elevation of 375 feet, significant portions of Portola State Park would be inundated. Depending upon the height of the dam, minor to major changes would result in the physical features of the park. Many fine redwoods would have to be removed in the reservoir clearing operation. Many others could be adversely affected by a rising water table due to the storage of water in the Pescadero Creek canyon. Major changes would be necessary in the operation of Portola State Park.

Portola State Park was created to preserve for posterity the prim redwood forests which it contains, as well as to provide inspirational recreational experiences to its visitors. The epartment of Parks and Recreation is unalterably opposed to ny development which would desecrate any of the esthetic or hysical values for which the park was created.

herefore, we recommend that consideration of the Worley Flat eservoir site be eliminated from consideration as a possible ater storage project in the Coastal San Mateo County Investigation.

oma Mar Canyon Reservoir

he proposed Loma Mar Canyon reservoir would inundate a portion of ortola State Park and a major portion of San Mateo County Memorial ark. It is our firm belief that insofar as is physically possible, ublic works should be constructed in a manner which maximizes atural resources enhancement and minimizes detriments to existing atural resources. We do not believe that the recreational ombination of esthetic and economic values which would be destroyed y this proposed reservoir can be replaced by those created by the eservoir.

e recommend that the Department of Water Resources eliminate the oma Mar Canyon reservoir site from consideration as a possible ater storage project in the Coastal San Mateo County Investigation.

l Oso Reservoir

his proposed reservoir lies within an area in which the Division of eaches and Parks is contemplating the expansion of Big Basin edwoods State Park. It is planned, by the acquisition of lands n this area (Waddell Creek) to tie together several scattered tate park ownerships and thus create a unified area from Big Basin roper to the ocean. It is also noted that the West Waddell Branch f the proposed reservoir would inundate a portion of the existing ig Basin State Park.

he Declaration of Purpose in the Master Plan for Big Basin Redwoods tate Park states in part, "....Big Basin Redwoods State Park has s its purpose the making available to the people forever, for their nspiration, enlightenment and enjoyment, in an essentially natural ondition, the entire watersheds of Waddell and Ano Nuevo Creeks....". he Department of Parks and Recreation considers that any development hich would alter the natural drainage pattern of the area or in any ther way alter in character other natural resources provided by the rea, would be inimical to park purposes in the existing and future lanned areas of Big Basin Redwoods State Park.

e recommend against consideration of the El Oso site as a possible ater storage project in the Coastal San Mateo County Investigation.

Upper Butano Reservoir and Pigeon Point Project

Both reservoir projects would inundate small portions of Butano State Park. It is not expected that either inundation would cause serious damage to park values.

It is recommended that if either of these projects are to be considered further every possible precaution should be taken in the planning process to prevent destruction of existing park values and every effort be made to enhance park and recreation values by judicious location, sizing and operation of the project.

/S/ Charles A. DeTurk
Director

COASTAL SAN MATEO COUNTY INVESTIGATION

A RECREATION RECONNAISSANCE OF 14 POTENTIAL RESERVOIR SITES

"A STUDY OF POTENTIAL AREA-WIDE RESERVOIR ASSOCIATED RECREATION DEMAND AND DATA FOR COMPILATION OF UNIT BENEFIT"

By
Stanley J. Thompson
Recreation Planner III

Under the Supervision of
Henry A. Hjersman
Assistant Supervisor

And

William J. Haussler
Supervisor

RECREATION CONTRACT SERVICES UNIT
DIVISION OF BEACHES AND PARKS
DEPARTMENT OF PARKS AND RECREATION

MARCH 1964

COASTAL SAN MATEO COUNTY INVESTIGATION

Introduction

This report has been prepared by the Recreation Contract Services Unit, Division of Beaches and Parks, as a portion of the services contracted by the Department of Water Resources under Interagency Agreement 252781. Specific authorization for recreation services to the Coastal San Mateo County Investigation is contained in Department of Water Resources Work Order Assignment No. 404-0300 issued by the Bay Area Branch on December 2, 1963, and revised on January 3, 1964. This work order requests that the Recreation Contract Services Unit provide the following services:

1. A recreation reconnaissance of 14 potential reservoir sites currently under investigation.

2. A general estimate of demand for reservoir water-associated recreation in the investigation area.

3. A compilation of data for use in determining recreation benefits.

4. A detailed recreation land use plan for the initial feature(s).

5. A prediction of recreation use for the initial feature(s).

6. An estimate of recreation development costs.

7. Assistance to the branch economist in computation of recreation benefits creditable to initial feature(s).

This report is broken into two sections covering the first three items outlined above. Items 4 through 7 will be covered in a subsequent report or reports once the initial feature or features are identified.

RECREATION RECONNAISSANCE
COASTAL SAN MATEO COUNTY

Location of the Study Area

The study area encompasses the coastal drainages of southern San Mateo County and a small portion of northern Santa Cruz County. The Pacific Ocean bounds the study area on the west; the outer ridges of the coast range form the east boundary. The north boundary of the area is Montara Mountain, a transverse ridge which runs to the ocean. The south boundary of the area is the Finney Creek drainage. This creek empties into the ocean near the San Mateo-Santa Cruz County Line. One reservoir area, which has been investigated for potential water supply, lies outside of the study area. This reservoir site, El Oso, lies on Waddell Creek immediately south of the study area boundary.

The City of Half Moon Bay constitutes the only incorporated city within the study area. Other communities include Montara, Princeton, El Granada, Moss Beach, San Gregorio, Pescadero, and La Honda. At the present time the economy of the area is based upon agriculture, recreation, and lumber.

Accessibility

The major highway serving the coastal area is State Highway 1, the Cabrillo Highway, which is located near and runs parallel to the coastline. This highway is generally two lanes, however, portions are built to four-lane expressway standards. Future highway development plans call for improving the entire route to expressway or freeway standards. The Devils Slide area, immediately north of the study area is periodically closed by slides during the winter months; a factor which prevents dependable year-around access from the major San Francisco-Pacifica metropolitan complex. State Highway 5, the Skyline Boulevard, parallels the east boundary of the study area. Highway 5 is a two-lane highway which originate in San Francisco and terminates in the mountains west of Saratoga. The highway will eventually be extended to connect with Highway 17 east of Santa Cruz.

Only two east-west highways serve the study area, the Belmont-Half Moon Bay Road and the La Honda Road. Both of these routes are paved two-lane mountain roads developed to somewhat less than State highway standards. Several improved and unimproved county roads connect the coastside area with State Highway 5. Access acts as a major barrier to the development of the coastal San Mateo area. As highways are improved, development of the area will be accelerat

Topography

The coastal portion of San Mateo County may be characterized as having three general topographic types. These types constitute belts running in a north-south direction paralleling the coastline. The outermost (coastside) consists of coastal terraces. These are relatively flat or gently undulating areas which occur above the coastline. The next belt to the east consists of the gently slopin and more steep foothills of the coast range proper. The upland are along the eastern boundary of the study area constitute the third general topographic type. The interior mountain areas are characterized by high ridges and steep-sided canyons.

rom the standpoint of topography, the coastal terrace and the oothill areas offer the best opportunity for recreation develop- ent. The interior mountain areas are generally too steep to ermit extensive recreation development.

limate

ven though the study area is small, there are quite considerable ariations in climate. The coastal terraces and rolling foothill reas are exposed to the coast and are subject to a strictly aritime climate. Westerly winds are common throughout the year. og is common during the summer and fall. Temperatures are cool hroughout the year. Variations between night and daytime tempera- ures and between winter and summer temperatures are slight. The nterior mountains are less subject to the winds and, although orning fog is common, it seldom persists throughout the day, s is characteristic of the coast. The range of daily and seasona- le temperatures is wider in the mountain area than along the oast, although extremely warm or cold temperatures are rare. The mountain area receives precipitation nearly twice that received on the coast. The upper portions of the study area commonly receive some snow during the winter, but this seldom persists for extended periods of time. Generally, the climate in the mountain areas is more conducive to reservoir recreation activities than is the climate of the exposed coastal area.

Vegetative Cover

As would be expected, the vegetative cover types closely parallel the topography and climate of the area. The coastal terraces were once grass-covered plains. Some of the canyons which cut through the terraces support sparse stands of coastal chaparral. Native trees are scant, but have been augmented by plantings of Monterey pine, Monterey cypress and eucalyptus. These plantings were established to act as wind barriers in some areas. The plains now constitute the major agricultural portion of the study area. Brussel sprouts, artichokes, and flower crops are the major agricultural items produced. Most of the limited urbanization which is occurring in the study area is occurring on the coastal terraces

The cover types in the foothill area are more variable. The ridgetops and south and west facing slopes are mostly grassland areas. The north-facing slopes support stands of coastal chaparral. Some tree cover occurs in the canyons and occasionally on the east-facing, sheltered slopes. Tree cover has been augmented in places by plantings of Monterey pine and eucalyptus. A considerable portion of the foothill area is coming under cultivation where slopes permit. Grain and hay crops are being produced. Much of the area is grazed by livestock.

The upland mountain areas also support a variety of vegetative types. The higher ridges are rather open oak woodlands. The larger canyons and some of the cooler and moister ridges support dense stands of redwood and Douglasfir. The redwood thins leaving Douglasfir stands on the drier slopes. The mountain area is generally well wooded. Some of the timbered areas have been heavily logged and second-growth timber is much in evidence. Other areas, mostly within existing public parks and in areas subdivided for summer homes, have been left unlogged. Many of the small flats within this area are cultivated for a variety of crops. Where soil and moisture conditions are favorable, Christmas tree farms have been developed. Those areas which lie between the foothills and the upland mountainous areas present the best potential for recreation development.

Over-all Attractiveness

The Coastal San Mateo area presents a study of contrasts. Each portion of the area has some attraction of its own and the whole area is a panorama of varying cover and topographic types. The dominant feature of the study area is the spectacular coastline. Sandy beaches are interspersed with rugged marine cliffs and rock outcrops. The coastline is visited by hundreds of thousands of recreationists each year. The coastal terraces overlooking the ocean are not as spectacular as is the coastline itself, but the pastoral scene of various agricultural types is attractive and interesting. The rolling foothills, inland from the coastal plain, are probably the least attractive of the areas in the region. But even here the diversity of cover and the interspersion of cultivated and uncultivated areas add interest to the area. The foothill area, because of the diversity of cover and use types, supports a variety of wildlife. The mountainous and eastern-most portion of the study area consists of the high ridges of the coast range. A considerable portion of this area is heavily timbered. The cool, moist canyons support dense groves of redwood and Douglasfir, while on the higher ridges Douglasfir and deciduous trees predominate the forested area. As with other forested areas of the State, these areas have long been attractive to recreationists. These forested areas provide a cool, relaxing respite from the hustle of work-a-day activities. The popularity of the mountains is evidenced by the number of summer homes throughout the area.

Developability

The developability of an area is defined as the combination of physical factors which determines whether or not recreation facilities can be developed. A number of factors enter into the determination of developability. Of prime concern is terrain. Slopes must be gentle enough to allow for developments. Unless suitable slopes within reasonable proximity of the reservoir are available for development, recreation use will be negligible. Developable areas must also be reasonably accessible. The coastal terrace and foothill areas generally provide the best opportunity for recreation development, although even here access to planned use areas can be a problem. The mountain areas are steep and developable and accessible terrain is scant.

Existing Recreation Development

The study area has long attracted recreationists. This is evidence by the extensive recreation-oriented development in the area. Existing development consists of private, semiprivate and public recreation facilities. Private development consists of numerous summer cabins scattered through the upland portions of the study area. Concentrations of such developments are found in Redwood Terrace, La Honda, Loma Mar, and Butano Park. Some summer home development also occurs along the coast. Semiprivate recreation development consists of many areas developed by church groups, scout groups, and other organizations. A few commercial recreation developments, areas developed with private capital, are available for public use on a fee basis. Public park and recreation facilities are provided by both county and state agencies. San Mateo County operates two park areas within the study area. Memorial Park, located on Pescadero Creek, is intensively developed for both overnight and day-use activities. McDonald Park, which is presently under development, is located on Upper San Gregorio Creek. This park area will be developed with riding and hiking trails and some camping areas. The State Division of Beaches and Parks operates several park facilities within the study area. The San Mateo Beaches State Park consists of numerous parcels of ocean frontage. Most of these areas support only limited development at the present time. Portola State Park is located in the upper portion of the Pescadero Creek Watershed. Portola is a park developed and operated for the preservation and interpretation of the redwood ecological type. The park has 60 developed camp units and 106 picnic units. Butano State Park is also a redwood-oriented park area. The park, located on Little Butano Creek, is currently under development. Initial development will include 90 camp units and attendant sanitary facilities, utilities, access roads and trails. The target date for completion of the initial stage development is June 1965.

Big Basin State Park, the first unit of the State Park System, is located immediately southeast of the study area. Those developments proposed in the southern end of the study area would have an effect on Big Basin. The full significance of this effect is not analyzed in the report.

Table 1 summarizes the use of the public park facilities where estimates are available.

TABLE 1

Use of Public Park Areas
Coastal San Mateo County
1963

Park Area	Total Visitors
San Mateo County Memorial Park	150,372
San Mateo Coast State Beaches	1,326,400
Portola State Park	132,911
Big Basin State Park	767,711

Although there are a number of reservoirs in the study area, none are developed to accommodate recreation use. Some privately-owned reservoirs are used to a limited extent for angling on a "permission only" basis. Until a year ago, two of these reservoirs, located on Arroyo de los Frijoles, were planted with trout by the Department of Fish and Game. These were operated by a local sportsmen's club which charged a fee for entry. This has now been discontinued. The Crystal Springs Reservoir complex, owned by the City of San Francisco, is located adjacent to the study area. These reservoirs and the surrounding watersheds are closed to all entry to prevent apparent or real damage to the domestic water supply.

It may be that at some future date, limited recreation development and use may be permitted.

Planned Recreation Development

The State Division of Beaches and Parks has tentative plans for a considerable amount of additional acquisition and development within the study area.

San Mateo Coast State Beaches will be expanded in several areas, and developed to provide for additional day-use and camping activities. Areas slated for acquisition and/or development include the coastal area near Half Moon Bay, areas at the mouth of San Gregorio and Pescadero Creeks, the Bean Hollow area and the Ano Nuevo area. Implementation of these plans will have little direct effect on the reservoir developments under investigation, however, planned beach developments would add to the general recreation attraction of the Coastal San Mateo area.

Present plans call for some additional acquisition surrounding Portola State Park, but there are no immediate plans for additional development in this area. Portola State Park would be affected by reservoir construction on the Pescadero Creek Watershed. The general effects of reservoir development on Portola State Park are discussed in a later section of this report.

Butano State Park is scheduled for initial development starting sometime in the 1963-64 fiscal year. Facilities for camping will probably be available for use during the 1965 recreation season. The lower portion of the park is slated for intensive development, while the upland portions of the park will be left in a pristine condition for the esthetic enjoyment of recreationists. Development in this area will consist of trails only. Some additional acquisition is planned for Butano State Park. Construction of the Upper Butano Reservoir would affect park development.

Additional plans call for the acquisition and development of a large portion of the Waddell Creek Watershed. The area to be acquired would be contiguous with Big Basin Redwoods State Park. Portions of the area, mostly in the Waddell Creek Canyon, would be developed primarily for overnight use. The proposed El Oso Reservoir would inundate a portion of the area planned for future recreation development.

San Mateo County's plans for development of McDonald Park were discussed in the preceding section of the report.

Potential for Reservoir Recreation Development

The potential for the development of reservoir recreation areas is determined largely by evaluating attractiveness and developability. Such factors as accessibility, location, reservoir size and operation are also important considerations. All of these factors are closely interrelated, and vary between reservoir sites

Slopes must be gentle enough to allow for development; generally less than 25%. It is desirable that these slopes have sufficient tree cover to provide an attractive setting for recreation development and to provide the privacy desired by recreationists. In this particular area shade is of less importance than in the warmer parts of the State. Consequently, from the point of view of recreation, an open stand is preferable to a dense tree stand. On the exposed outer coast trees can serve as an important barrier to the prevailing offshore winds.

Unfortunately, the desirable balance between topography and vegetative cover is lacking in most of the coastal San Mateo area. Those areas which are well wooded are generally too steep for recreational development. Conversely, those areas flat enough for development lack tree cover.

All of the reservoir sites are located in close proximity to a large urbanized area so that demand for recreation facilities will be present. Some of the reservoir areas are more accessible to this population than others. Areas suitable for development on individual reservoirs will present varying access problems.

The sizes of the reservoirs planned are variable. Some of the reservoirs are so small as to limit the types of recreation activities allowable. For example, high-speed boating and water skiing would be undesirable on reservoirs much smaller than 200 acres. On the larger reservoirs these activities would be permissible. Schedules have not yet been developed for the operation of the reservoirs for other project purposes. It is assumed that a usable pool will be maintained for recreation.

If such a pool is not provided, the potential of any of the reservoirs will be seriously impaired. It is also assumed that other project purposes will not restrict the recreational use of the reservoirs. Restrictions on the use of the reservoirs imposed by public health requirements or for other reasons will have a negative effect on the recreation potential of the reservoirs.

Reservoir Sites Considered

This portion of the report presents a brief description and a general recreation evaluation of each of the fourteen reservoir sites considered. The location of the sites examined is shown in Table 2. Overall potential ratings for the reservoirs, based upon attractiveness, location, developability, size, and access are outlined in Table 3.

In making these evaluations it was necessary to make several assumptions. Although some of these have been discussed previousl they are repeated below for emphasis. It is assumed that:

1. The reservoir recreation areas will be developed and made available for public recreation use.

2. General recreation activities, including water contact sports, will be permitted.

3. Access to the study area will be improved in the near future.

4. The operation of the reservoirs for other project purposes will be such that the reservoirs will be usable for recreation.

TABLE 2

Reservoir Sites Examined
Coastal San Mateo County Investigation

Reservoir Site	Dam Site Location S	T	R	Pool Elevation	Surface Acres
Denniston	Land Grant-Section Lines Not Established			250	130
Mills	34	5S	5W	440	130
Upper Purisima	Land Grant-Section Lines Not Established			400	200
Lower Purisima	16	6S	5W	320	270
Lobitos	Land Grant-Section Lines Not Established			360	140
San Gregorio	Land Grant-Section Lines Not Established			240	1,280
Loma Mar Canyon	4	8S	4W	360	1,100
Worley Flat	35	8S	4W	440	860
Worley Flat	35	8S	4W	375	440
Upper Butano	Land Grant-Section Lines Not Established			240	875
Bean Hollow	Land Grant-Section Lines Not Established			240	570
Gazos	Land Grant-Section Lines Not Established			240	510
Whitehouse	Land Grant-Section Lines Not Established			280	215
El Oso	26	9S	4W	250	253

enniston Reservoir Site:

he Denniston Reservoir Site lies almost directly east of the Half oon Bay Airport. The proposed reservoir would have a surface rea of 130 acres at maximum water conservation pool.

he Denniston Creek Canyon is a rather steep U-shaped canyon. The rea to be inundated would cover most of the readily developable ecreation land. Some small areas could be developed for recreaion in the side canyons and at the upper end of the reservoir. owever, it would be difficult to develop access to these areas. he north facing slopes are mostly brushy with some patches of ucalyptus in the side canyons. The ridge tops and south facing lopes are more open with scattered patches of chaparral. The emaining areas are covered with annual grasses.

he Denniston Creek area presently receives some recreation use. he Brisbane Rod and Gun Club operates a rifle and pistol range n a portion of the area which would be inundated by the reservoir. t would be difficult to develop recreation facilities at this ite. The area is not attractive because of the almost total ack of trees. Slopes surrounding the reservoir are steep with ery limited area available for recreation development. It will e difficult to develop access to the few usable areas. The overll potential of the area is limited.

ills Reservoir Site:

ills Reservoir Site is located on Mills Creek approximately 4 miles outhwest of Half Moon Bay. Access to the area is by the Higgins anyon county road and private road to the Murray Ranch. The proosed reservoir, at a surface elevation of 440 feet, would cover approximately 130 acres. Most of the slopes surrounding this site are steep. However, one area near the left dam abutment could be developed for recreation use.

Tree cover is scant on the slopes surrounding the Mills Site. Some portions of the canyon have been planted with eucalyptus. Most of this cover would be flooded by reservoir construction. Recreation development on this site would involve extensive landscaping to provide the esthetic setting desirable for recreation use.

While the Mills Reservoir Site is not now particularly attractive, the area does have some recreation development possibilities. The size of the reservoir would preclude some recreational uses, such as high-speed boating. Assuming that adequate facilities and landscaping are provided, the reservoir would be suitable for such activities as swimming, angling, and picnicking.

Upper Purisima Reservoir Site

The Upper Purisima Reservoir Site is located on Purisima Creek approximately 3 miles northeast of State Highway 1. Access to the site is by improved county road. At a pool elevation of 400 feet, the reservoir would cover approximately 200 acres.

Terrain surrounding the reservoir is moderate to steep. Several areas would, however, be available for recreation development. The best of these areas, from the standpoint of vegetative cover, lies at the extreme upper end of the reservoir. This area would be most affected by reservoir fluctuation. Reservoir drawdown would make it difficult to develop water-associated recreation facilities which would be available for use throughout the year.

he vegetative cover on the south facing slopes consists of pen grassland with a few scattered patches of brush. The orth slopes support brush and, in the side canyons, some cattered tree cover. Some of the more gently sloping ridgeops are presently under cultivation.

he Upper Purisima Site is not unattractive for recreation. ome supplemental landscaping would be necessary to maximize he recreation potential of the site, as those areas where slopes re gentle enough to support development lack tree cover. The ize and shape of the reservoir would tend to limit water surface se to some extent.

ower Purisima Reservoir Site

ower Purisima Reservoir Site is located approximately 2 miles ownstream from the upper site and is about 1 mile east of State ighway 1. At a water conservation pool with a surface elevation f 320 feet, the reservoir would inundate about 270 acres.

The developability of the area is much the same as the Upper Purisima Site. Most slopes are steep, but area is available for development.

The cover pattern tends to be more open than at Upper Purisima. Some tree cover is present in the canyons, but most of the drier slopes lack even brush cover.

Because of the scant tree cover, the Lower Purisima Site is not as attractive as is the upper site. Perhaps it would be worth investigating the lower reservoir site at an elevation of 400 feet.

The vegetative cover on the south facing slopes consists of open grassland with a few scattered patches of brush. The north slopes support brush and, in the side canyons, some scattered tree cover. Some of the more gently sloping ridgetops are presently under cultivation.

The Upper Purisima Site is not unattractive for recreation. Some supplemental landscaping would be necessary to maximize the recreation potential of the site, as those areas where slopes are gentle enough to support development lack tree cover. The size and shape of the reservoir would tend to limit water surface use to some extent.

Lower Purisima Reservoir Site

Lower Purisima Reservoir Site is located approximately 2 miles downstream from the upper site and is about 1 mile east of State Highway 1. At a water conservation pool with a surface elevation of 320 feet, the reservoir would inundate about 270 acres.

The developability of the area is much the same as the Upper Purisima Site. Most slopes are steep, but area is available for development.

The cover pattern tends to be more open than at Upper Purisima. Some tree cover is present in the canyons, but most of the drier slopes lack even brush cover.

Because of the scant tree cover, the Lower Purisima Site is not as attractive as is the upper site. Perhaps it would be worth investigating the lower reservoir site at an elevation of 400 feet

The vegetative cover surrounding the reservoir varies. The upper end of the reservoir is densely wooded with redwood and Douglas-fir. The north-facing slopes further down the reservoir are brushy with some tree cover in the tributary canyons. The south-facing slopes are mostly open grassland. At the lower end of the reservoir, where slopes permit, much of the area is under cultivation.

Several areas are suitable for recreation development. These areas would, however, present access problems. Some of the developable areas would require landscaping.

The size of the reservoir would be suitable for a wide variety of recreation activities. The site would prove attractive for recreation development and use.

Loma Mar Canyon Reservoir Site

The Loma Mar Canyon Site is located on Pescadero Creek about three miles east of Pescadero. Access to the site is by paved, high standard county road. The size of the planned reservoir, 1,100 surface acres at elevation 360 feet, would be suitable for most recreation uses.

The Pescadero Creek Canyon is a rather typical V-shaped canyon. The canyon bottom has some area suitable for development. The upper slopes are mostly steep with developable areas limited and inaccessible. The Pescadero Creek Canyon supports a dense stand of redwood and Douglasfir. On the upper slopes the tree cover thins to some extent, but is still attractive for recreation development. The attractiveness of the Pescadero Creek area is self-evident. Much of the area is developed with summer homes, public parks and organizational camps. The lower portion of the canyon, which supports most of the existing recreation development would be inundated by the proposed reservoir. The upper slopes are too steep for extensive development except at the upper end of the reservoir area. Two park areas would be affected by the construction of the Loma Mar Canyon Reservoir. San Mateo County Memorial Park would be almost totally inundated and Portola State Park would be partially flooded. In addition, several private and organizational camp areas would be inundated. Inundation of these park and recreation facilities would be undesirable.

The Loma Mar Canyon site is attractive but not very developable. From a strictly recreational point of view, it would be difficult if not impossible to replace the recreation potential of the two public park areas and several organizational areas which would be destroyed by reservoir construction.

Worley Flat Reservoir Site

The Worley Flat Site is located on Pescadero Creek approximately two miles upstream from the Loma Mar Canyon Site and about 3/4 of a mile upstream from the east boundary of the San Mateo County Park. Two alternate reservoir sizes are being studied. The larger reserv would have a water surface elevation of 440 feet and would cover approximately 860 acres. The smaller reservoir would cover 440 acres at water surface elevation, 375 feet. Cover and terrain characteristics are similar to those described for the Loma Mar Canyon Reservoir Site. The Pescadero Creek Canyon is densely woode with the cover tending to thin on the higher ridges. Much of the area has been or is being logged. The slopes surrounding the reservoir are generally steep. However, several areas are available for recreation development. Access to these areas would be difficult because of the steepness of the terrain.

ither of the proposed reservoirs would back into Portola State ark. The larger reservoir would inundate most of the developed ortion of the park. The lower reservoir, though still flooding a ortion of the park, would be less detrimental to park operation. owever, it should be pointed out that reservoir construction would nvolve vegetative clearing. The denuded areas thus created would ertainly not enhance the State park area. Because of this detrimental effect on Portola State Park, it might be desirable to investigate a still lower pool elevation. A pool elevation of 330 eet would probably have little effect on the State park area. A somewhat smaller reservoir, located between Memorial Park and Portola Park, would have considerable potential for recreation use. The Worley Flat Reservoir(s) would provide an attractive setting for recreation development. Terrain will be a limiting factor to development and use. The potential effects of reservoir construction on existing State park facilities should be evaluated carefully in future consideration of these reservoir sites.

Upper Butano Reservoir Site

The Upper Butano Reservoir Site is located on Butano Creek approximately 25 miles south of Half Moon Bay and about four airline miles inland from the ocean. The proposed reservoir would have a surface area of 875 acres at a water surface elevation of 240 feet. Access to the site is by the Cloverdale Road, an improved county road.

The Butano Reservoir would have two main arms, one backing into Butano Creek and one into Little Butano Creek. The Butano Creek arm would be in a steep well wooded canyon, the upper end of which is developed with private summer homes. This rather extensive summer home development is known as Butano Park. Development possibilities on this arm are limited by the steep terrain. The Little Butano arm would back south into the Butano State Park. Slopes surrounding the Little Butano arm are more gentle and less heavily wooded. The Little Butano arm offers the greatest potential for recreation development. Such development would probably require some landscaping to augment the scant vegetation on the developable areas.

The Butano State Park has been acquired by the State for the purpose of preserving a large stand of redwood in the upper Little Butano Canyon. The park is a relatively recent addition to the State Park System and is under development. The first stage of development, consisting of camping and picnicking facilities, is planned for completion in 1965. The proposed reservoir would necessitate relocation of the park access road, but would not otherwise affect current park development.

It is possible that with proper planning, Upper Butano Reservoir could provide an enhancement to the Butano State Park area. The amount of such enhancement would depend partially upon the operational characteristics of the reservoir.

Bean Hollow Reservoir Site

The proposed Bean Hollow Reservoir would be located on Arroyo de los Frijoles about 25 miles south of Half Moon Bay. At a water surface elevation of 240 feet the reservoir would cover about 570 acres. Present access to the site is limited to private ranch roads Should the reservoir be constructed, it would be necessary to provid public access.

Bean Hollow Reservoir would be constructed only as a portion of the Pigeon Point Project which also includes the proposed Gazos Reservoir There is very little natural drainage into the Arroyo de los Frijoles Water for storage in Bean Hollow Reservoir, as a part of the Pigeon

Point Project, would be diverted from Pescadero and/or Butano Creek. Bean Hollow Reservoir would be located in a canyon on the coastal plain. Slopes at the upper end of the proposed reservoir are capable of supporting development. Reservoir drawdown in these areas would expose large mud flats and would make development difficult and expensive. Tree cover is almost entirely lacking in this area. The sheltered north-facing slopes support some patches of coastal chaparral, but the area is mostly grass covered. Some cultivation occurs on the more moderate slopes. The area would be subject to coastal fog and wind.

The Bean Hollow Reservoir Site, because of the lack of tree cover, would not prove attractive to recreationists. Reservoir operation would further impair the recreation potential of the site.

Gazos Reservoir Site

The Gazos Reservoir Site is located on Gazos Creek approximately 2-1/2 miles southeast of Pigeon Point. The reservoir would cover approximately 510 acres at water surface elevation 240 feet. The reservoir would be long and narrow with limited surface area available for high-speed boating activities. Access to the area is by graded county road. The area is most accessible from the Pigeon Point area.

Gazos Reservoir does not offer much area for recreation development. Most of the slopes surrounding the reservoir are extremely steep. Access to developable areas would be difficult to develop. Vegetative cover consists of logged-over and second-growth redwood and Douglasfir. The vegetative pattern would provide an attractive setting for recreation development. The over-all potential for recreation development and use at Gazos Reservoir is limited by the amount of area available for recreation development. Cover, although not as attractive as it might be, is adequate. The size of the reservoir would allow for most water-associated recreation activities although the long, narrow shape of the reservoir would tend to restrict high-speed boating.

Whitehouse Reservoir Site

Whitehouse Reservoir Site is located on Whitehouse Creek. The reservoir area lies approximately four airline miles northeast of Ano Nuevo Point and is accessible from State Highway No. 1 and the Whitehouse Creek county road. The reservoir would cover about 215 acres at a pool elevation of 280 feet. The slopes at the lower and upper ends of the reservoir site are steep. Slopes along the mid-portion of the reservoir could support some development. The area surrounding the Whitehouse Creek Reservoir Site is open grassland. Some tree cover occurs in the small tributary canyons and at the upper end of the reservoir. Most of the ridgetops are cultivated for grain or hay crops. Located on the exposed outer coast, the reservoir area would be subject to summer fog and westerly winds. Some shelter from the wind could be provided by utilizing the natu topographic features of the area and by establishing tree cover in the areas planned for development.

The size of the reservoir will preclude some recreation activities, such as high-speed boating and water skiing. Such activities as picnicking and swimming could be accommodated.

El Oso Reservoir Site

The El Oso Reservoir Site is located on Waddell Creek approximatel three miles upstream from the mouth.

h proposed reservoir would cover approximately 253 acres at a ater surface elevation of 250 feet.

uring the field reconnaissance, I did not have an opportunity o have an "on the ground" look at the site as the gate on the cess road was locked. It appears that the canyon is steep and el wooded. Area for recreation development will probably be cant although map study indicates some area near the left dam tment. Access to this area would be difficult to develop.

e reservoir, as presently planned, would back water into undeveloped rtions of Big Basin Redwood State Park. This would have little fect upon the park, but would provide access along the reservoir ore. Unless these access points were well planned, some maintence problems would be incurred.

the present time, the Waddell Creek Canyon is in private ownership. wever, it has been proposed that the Division of Beaches and Parks quire this parcel to tie together several scattered state ownerships d provide a contiguous area running to the ocean. Preliminary velopment plans indicate intensive development below the reservoir ea and an access road running into Big Basin. Although reservoir nstruction in this area would involve realignment of the proposed cess road, the reservoir would probably enhance the other recreation velopment in the area. The relationship between reservoir development and proposed park development would require some additional udy before a final evaluation can be made.

TABLE 3

Summary of Reservoir Recreation Potential Coastal San Mateo County Investigation

Reservoir Site	Attractiveness	Developability	Access	Size	Overall Potential
Denniston	P	P	F	P	P
Mills	P	F	F	F	F
Upper Purisima	F	F	G	F	F
Lower Purisima	P	F	G	F	F
Lobitos	P	F	P	P	P
San Gregorio	F	F	G	G	G
Loma Mar Canyon	G	P	G	F	F
Worley Flat	G	F	F	F	F
Upper Butano	F	G	F	G	G
Bean Hollow	P	P	F	F	P
Gazos	F	P	F	F	F
Whitehouse	P	F	G	F	F
El Oso	G	P	P	F	F

G= Good

F= Fair

P= Poor

POTENTIAL AREA-WIDE DEMAND FOR RESERVOIR ASSOCIATED RECREATION DEMAND AND DATA FOR COMPILATION OF UNIT BENEFIT COASTAL SAN MATEO COUNTY STUDY AREA

ntroduction

ne Coastal San Mateo area has a good potential for the use of eservoir-associated recreation facilities. The amount of potential hich an area possesses for such development is dependent upon the ttractiveness and developability of the area and a third factor, emand. The first two of these factors has been discussed previously. his section of the report presents estimates of total demand for eservoir-associated recreation facilities.

he term "recreation demand" is not to be confused with the term recreation use." Recreation demand represents the desire of eople to participate in recreation activities at a given place. hile attractiveness and developability play a part in determining ecreation demand, location and accessibility are probably the most mportant considerations. On the other hand, recreation use is argely dependent upon the developability of the potential recreation site. Once initial project features are identified, it will e possible to refine the demand estimates and estimate potential ecreation use.

Recreation demand can be broken into two general types, day use demand and camping demand. The same factors enter into the determination of either type of demand. However, the emphasis is somewhat different. Day use demand is determined largely by the availability of an area to the people which it will serve. Population surrounding the potential recreation area appears to be the greatest single factor influencing day use demand. It is usually assumed that the population within 50 miles of the recreation development will generate most of the demand for day use facilities.

The Coastal San Mateo area presents an interesting situation relative to population and accessibility. The study area itself had a relatively low population, 7,635, in 1960. It is, however, surrounded by some of the densest concentrations of population in California. The area is bordered by the Pacifica- Daly City-San Francisco complex to the north, the peninsula communities to the east, the San Jose area to the south and east, and Santa Cruz to the south. The area is also within reach of the East Bay area The inaccessibility of the area, which has deterred urbanization, may also detract somewhat from the full utilization of the recreation potential of the area. However, as highway routes are impro the coastal area will become increasingly available to population at a greater distance from the area.

Camping, on the other hand, although influenced by surrounding population, is more dependent upon attractiveness, developability and other factors. Making an adequate study of demand for campin facilities is much more difficult than the determination of deman for day use facilities. Required travel distance does not seem t affect the camper to the same degree as it does the day user. Demand for camping facilities will originate from two general sources:

1. Those who visit the Coastal San Mateo area specifically for the purpose of visiting the reservoir areas.
2. "Casual" users who will visit the facilities for convenienc only.

A large portion of the specific demand for water-associated campi facilities in the Coastal San Mateo area will originate from withi the day use service area, viz., from within 50 miles of the reservoir area. Another portion of demand for reservoir assocated camping facilities will originate from beyond 50 miles, bt probably from within 400-500 miles. The casual visitors wll originate from the highway travelers on State Highway No. 1 ad will represent a wide cross-section of the county. It is flt that this latter class of visitors will contribute a portion, bt probably an insignificant portion, of the total camping demand.

I is expected that there will be a large demand in the Coastal Sn Mateo area for both camping and day use activities. The aount of demand which can be satisfied by reservoir development wll depend largely upon the reservoirs developed and the recreaton facilities provided. The attractiveness of the areas examined n the recreation reconnaissance is such that camping would probably ot be as readily accommodated as would day use. It is also true hat a proportionately larger portion of the total demand can be ccomodated on the relatively small areas developable for recreation.

ethods Used in Estimating Day Use Demand

asically, the method employed in estimating the potential day use emand for water-associated recreation use in the Coastal San Mateo rea involves the use of a distance-per capita demand relationship. he population living within a 50-mile radius of the approximate enter of the study area was broken into concentric service area ones, based upon road mileage from a central point within the study rea (San Mateo County Memorial Park). The population residing ithin each zone was tabulated.

Per capita demand estimates for each zone were made on the basis of demand figures derived from other water-associated recreation developments in California. Both the population and per capita demand rates are projected by commonly used methods. The population projections are based upon projection of total county populations. The per capita demand rates are projected on the basis of increases in recreation use in state and national parks and national forests.

Estimates of potential day use, water-associated recreation deman are shown in Table 4.

The following assumptions were made in preparing these estimates:

1. That the service area population in the Coastal San Mateo area will react to reservoir development in the same manner as service area populations surround such developments elsewhere in the State.

2. The reservoir areas are made available for general recreation use, including water contact sports.

3. The amount of leisure time, mobility, and income of recreationists will continue to increase in the future.

TABLE 4

Projected Demand for Reservoir Associated Day Use Recreation

Coastal San Mateo County Study Area

		1960 (Base)			1970		
Zone	Miles	Rate 1/	Pop. 2/	Dem. 3/	Rate	Pop.	Dem.
I	0-10	6.00	2,000	12,000	7.65	2,000	15,000
I	11-20	2.34	16,000	37,000	2.98	23,000	69,000
II	21-30	.96	510,000	490,000	1.22	740,000	903,000
I	31-40	.36	550,000	198,000	.46	785,000	361,000
V	41-50	.14	1,020,000	143,000	.18	1,215,000	219,000
Total Day Use Demand				880,000			1,567,000

		1980			1990		
Zone	Miles	Rate	Pop.	Dem.	Rate	Pop.	Dem.
I	0-10	9.30	3,000	28,000	10.95	4,000	44,000
I	11-20	3.62	30,000	109,000	4.26	38,000	162,000
II	21-30	1.48	930,000	1,376,000	1.74	1,090,000	1,897,000
I	31-40	.56	1,010,000	566,000	.66	1,220,000	805,000
V	41-50	.22	1,350,000	297,000	.26	1,490,000	387,000
Total Day Use Demand				2,376,000			3,295,000

		2000			2010		
Zone	Miles	Rate	Pop.	Dem.	Rate	Pop.	Dem.
I	0-10	12.60	5,000	63,000	14.25	7,000	100,000
I	11-20	4.90	50,000	245,000	5.54	61,000	338,000
I	21-30	2.00	1,250,000	2,500,000	2.26	1,395,000	3,153,000
I	31-40	.76	1,425,000	1,083,000	.86	1,614,000	1,388,000
V	41-50	.30	1,630,000	489,000	.34	1,750,000	395,000
Total Day Use Demand				4,380,000			5,574,000

		2020		
Zone	Miles	Rate	Pop.	Dem.
I	0-10	15.90	8,000	127,000
I	11-20	6.18	71,000	439,000
I	21-30	2.52	1,530,000	3,856,000
IV	31-40	.96	1,795,000	1,723,000
V	41-50	.38	1,815,000	690,000
Total Day Use Demand				6,835,000

Summary

Predicted Day Use Demand

Year	Visitor Days
1960 (Base)	880,000
1970	1,567,000
1980	2,376,000
1990	3,295,000
2000	4,380,000
2010	5,574,000
2020	6,835,000

1/ Per Capita Rate
2/ Population Within Zone
3/ Total Demand in Visitor Days

Data for Compilation of Day Use Unit Benefits

Average Party Size - 4.0

Average Length of Stay - 1 day

Average Travel Distance - See Table 5

Table 5

Probable Origin of Day Users
Coastal San Mateo County Investigation

Distance Traveled[1]	Percent of Day Users[2]
0-10 miles	1.4
11-20 miles	5.1
21-30 miles	57.0
31-40 miles	24.1
41-50 miles	12.4

[1] Average one-way travel distance.

[2] Average distribution of origin through year 2020. The distribution of day-use visitation will probably require some adjustment when actual projects are identified.

Methods Used in Estimating Camping Demand

According to the recreation demand estimates presented in the "California Public Outdoor Recreation Plan - Part II," camping demand will represent about 25 percent of the total recreation demand in the Bay Area in 1980. The same relationship between day use and camping holds true in San Mateo County specifically. The various types of camping are not differentiated, but this relationship will probably hold true for reservoir-associated camping demand.

Although there are many variables which govern camping demand, the demand estimates presented herein represent an empirical estimate based upon data in the "California Public Outdoor Recreation Plan - Part II." The following assumptions are necessary:

1. The demand for reservoir-associated camping will bear the same relationship to reservoir-associated day use as does general camping to general day use.

2. The 25 percent to 75 percent split between camping and day use will hold constant through 2020.

Camping demand estimates based upon these assumptions are presented in Table 6.

Table 6
Projected Demand for Reservoir Associated Camping
Coastal San Mateo County Study Area

Year	Day Use Demand	Camping Demand
1960 (base)	880,000	294,000
1970	1,567,000	522,000
1980	2,376,000	792,000
1990	3,295,000	1,098,000
2000	4,380,000	1,460,000
2010	5,574,000	1,858,000
2020	6,835,000	2,278,000

Total recreation demand is the summation of day use demand and camping demand. This summary appears in Table 7.

Table 7
Total Reservoir Recreation Demand
Coastal San Mateo County Investigation

Year	Day Use Demand	Camping Demand	Total Dema
1960 (base)	880,000	294,000	1,174,000
1970	1,567,000	522,000	2,089,000
1980	2,376,000	792,000	3,168,000
1990	3,295,000	1,098,000	4,393,000
2000	4,380,000	1,460,000	5,840,000
2010	5,574,000	1,858,000	7,432,000
2020	6,835,000	2,278,000	9,113,000

Data for Compilation of Camp Use Unit Benefits

Average party size - 4.0 people per party

Average length of stay - 2.0 days

Average Travel Distance - See Table 8

Table 8
Probable Origin of Camp Users
Coastal San Mateo Investigation

Distance Traveled[1]	Percent of Camp Users[2]
0-50 miles	62%
51-100 miles	10%
101-150 miles	7%
151-200 miles	6%
201-250 miles	4%
251-300 miles	3%
301-350 miles	3%
351-400 miles	2%
401-451 miles	1%
451-500 miles	1%
over 500 miles	1%

[1] Average one-way travel distance.

[2] Based on estimates of camp demand "C.P.O.R.P. Part II," Dwyer 1963 Unpublished, and work by A. Trice, for Jackson Valley I.D.

State of California **The Resources Agency of Calif**

Memorandum

To : Honorable William E. Warne, Director
Department of Water Resources

Attention: Mr. Charles McCullough, Chief
Bay Area Branch

From : **Department of Parks and Recreation**

Date : June 11, 1964

Subject : Transmittal of Rep
Coastal San Mateo Count
Investigation, "Studies
Recreation Land Use, Po
Recreation Use and Esti
Recreation Costs for De
Lower Purisima, Worley
and Pigeon Point Projec

Two copies of the attached subject report are transmitted herewith as partial fulfillment of Interagency Agreement No. 252781, wherein Parks performs recreation planning for Water Resources. The report was prepared at the request of Mr. Charles A. McCullough, Chief, Bay Area Branch, and constitutes the final portion of the work to be accomplished for the Coastal San Mateo County Investigation for the fiscal year 1963-64.

The subject report presents a description of potential recreation development, an estimate of approximate capacity of recreation development, an estimate of approximate capacity of recreation facilities, an estimate of recreation use and an estimate of recreation costs for the Denniston, Lower Purisima, Worley Flat and Pigeon Point reservoir projects.

It should be noted that the recommendations and views of the Department of Parks and Recreation concerning Worley Flat Reservoir and the Pigeon Point Project as stated in my May 4, 1964 memorandum to you, subject, "Transmittal of Report - A Recreation Reconnaissance of 14 Potential Reservoir Sites - Coastal San Mateo County Investigation", have not changed.

The Department of Parks and Recreation is still unalterably opposed to any development which would desecrate any of the esthetic or physical values of Portola State Park.

Should any of the reservoirs which have been studied in the Coastal San Mateo County Investigation be considered for definite project study, it would be appreciated if the Department of Parks and Recreation could enter into early discussions with Water Resources and/or the local constructing agency. The purpose of such discussi would be to prevent destruction of the esthetic values of park area to minimize damage to park features and facilities where esthetic values are not concerned, and to make every effort to enhance park and recreation values by properly locating, sizing and operating the water projects, wherever possible.

onorable William E. Warne

t is understood that the purpose of the Coastal San Mateo ounty Investigation is to recommend water development projects o satisfy local water needs in the coastal area of San Mateo ounty. It is further understood that the results of this nvestigation will be reported as a published Bulletin. Since t appears that there could be conflicts between water development nd State Park interests, the Department of Parks and Recreation ould appreciate the opportunity to review this Bulletin prior o publication.

hank you very much for your cooperation in this matter which s so important to the preservation and the enhancement of the tate Park System.

/S/ Charles A. DeTurk
Director

COASTAL SAN MATEO COUNTY INVESTIGATION

STUDIES OF RECREATION LAND USE, POTENTIAL RECREATION USE AND ESTIMATED RECREATION COSTS FOR DENNISTON, LOWER PURISIMA, WORLEY FLAT, AND PIGEON POINT PROJECTS

by

Stanley J. Thompson
Recreation Planner III

Under the Supervision of
Henry A. Hjersman
Assistant Supervisor

And

William J. Haussler
Supervisor

RECREATION CONTRACT SERVICES UNIT
DIVISION OF BEACHES AND PARKS
DEPARTMENT OF PARKS AND RECREATION

May 1964

COASTAL SAN MATEO COUNTY INVESTIGATION

GENERAL CONSIDERATIONS

Introduction

This report, the second of two on the recreation aspects of the investigation, has been prepared by the Recreation Contract Services Unit, Division of Beaches and Parks, as a portion of the services contracted for by the Department of Water Resources under Interagency Agreement 252781. Specific authorization for these recreation planning services is contained in Department of Water Resources Work Order Assignment No. 404-0300. The first recreation report for the Coastal San Mateo County Investigation, entitled "A Recreation Reconnaissance of 14 Potential Reservoir Sites," and "A Study of Potential Area-Wide Reservoir Associated Recreation Demand and Data for Compilation of Unit Benefit" has been transmitted to the Department of Water Resources.

Following completion of the reconnaissance report, the program manager identified five reservoir sites for further recreation consideration: Denniston, Lower Purisima, Worley Flat, Gazos, and Bean Hollow; the latter two reservoirs comprising the Pigeon Point Project. The location of these reservoir sites is shown on Plate D1.

This report presents a description of potential recreation development, an estimate of approximate capacity of recreation facilities, an estimate of recreation use and an estimate of recreation costs for each of the reservoir areas considered.

Summary of Recreation Reconnaissance

The recreation reconnaissance conducted in this area indicates that the coastal San Mateo area has considerable potential for recreation development and use. The area is generally attractive. However, the amount of developable terrain, access to developable areas, and the balance between attractive vegetative cover and developable terrain present problems on individual reservoir sites. Climate, especially wind and fog, may detract from the recreation potential of reservoir sites exposed to the outer coast. The potential for development and use depends on the individual reservoir sites to be developed.

Recreation Demand Potential

The coastal San Mateo County study area has a relatively small population, but is within easy driving distance of the metropolitan bay area. At the present time, road access presents a limited barrier to this population. As access is improved, the potential reservoirs will be within reach of additional heavily populated areas.

The demand study, completed in conjunction with the previous report, indicates that there will be considerable demand for reservoir associated recreation facilities in the study area. Table 1 summarizes the estimated demand for day use and camping facilities.

TABLE 1

SUMMARY OF POTENTIAL AREA-WIDE RECREATION DEMAND COASTAL SAN MATEO COUNTY STUDY AREA

Year	Day Use Demand	Camping Demand	Total Demand
1960 (base)	880,000	294,000	1,174,000
1970	1,567,000	522,000	2,089,000
1980	2,376,000	792,000	3,168,000
1990	3,295,000	1,098,000	4,393,000
2000	4,380,000	1,460,000	5,840,000
2010	5,574,000	1,858,000	7,432,000
2020	6,835,000	2,278,000	9,113,000

Reservoir Considerations

Four areas were identified for additional recreation study: Denniston Reservoir site, Lower Purisima Reservoir site, Worley Flat Reservoir site, and the Pigeon Point Project, which would consist of two reservoir sites, Bean Hollow and Gazos. The program manager identified the damsite and estimated a normal pool elevation for each of the reservoirs. In addition, the program manager furnished such mapping as was available. This mapping consisted of standard U.S.G.S. 7-1/2 minute quads enlarged to 1 inch to 400 feet. The contour interval on most of these maps is 40 feet, which made it difficult to complete a detailed analysis of the topography, specific developable recreation areas or access road alignments.

Operation schedules have not yet been developed for the reservoirs studied. While normal pool elevations were identified by the program manager, minimum pool elevations had to be assumed. The recreation plans were prepared on the assumption that the reservoir pools would be within the range of the given normal pool and the assumed minimum pool elevation during the recreation season. On some reservoirs, the range between normal and minimum pool is rather narrow. Operation of the reservoirs beyond these limits would impair recreation operation and use and would necessitate revision of the recreation plan.

The construction staging of the four reservoirs has not yet been determined. In preparing the estimates for recreation development and use, each reservoir was considered separate from all other potential projects.

All of these factors: size, elevation, operation, and constructio staging, are closely interrelated. Some of the reservoir areas ar rather small and would support only limited use. The Pigeon Point Project, on the other hand, would furhish a large water surface an would be suitable for a multitude of recreation uses. Should a combination of the Denniston Reservoir and the Pigeon Point Projec be constructed initially, it is probable that Pigeon Point would receive the most intensive use because of the variety of recreatio opportunities available. If only one of the four reservoirs is actually constructed, it would be used to near capacity even with severe drawdown. On the other hand, if a combination of reservoir is built, those with more stable water surfaces and a variety of types of recreation development would be more desirable from the point of view of recreation. These examples are given to illustrat some of the possible relationships and to demonstrate the importanc of these relationships to the recreation planning program.

ithout knowing the physical factors which determine these inter-
elationships, it was necessary to make a number of assumptions
n planning. It was assumed that there would be no restriction on
he types of recreation use permissible other than those imposed
y reservoir size; that the reservoirs would not be operated beyond
he limits set for the maximum and minimum pools; and that the staging
f the reservoirs would be such that all reservoirs would be used
o capacity within a few years of construction.

ecreation Land Use Plans

eneralized recreation land use plans, indicating full recreation
evelopment, were produced for each of the proposed reservoirs using
he available topographic mapping. These plans are included in the
ections dealing with each of the proposed reservoirs. As a conse-
uence of the lack of detailed mapping, the land use plates indicate
nly major types of use such as picnicking, camping, boating, and
oncession areas. Areas for swimming beaches, boat beaches, group
amping or picnicking, and other possible specific use areas are
ot shown.

ypes of Recreation Facilities

he types of use planned for the reservoirs are those commonly asso-
iated with reservoir recreation areas. Each of the areas designated
or a general type of use was examined as closely as possible, both
n the field and on the mapping. Very rough development plans were
roduced for each reservoir area. The number of facilities or
nits of each type was then determined on the basis of Division

of Beaches and Parks land use standards. These standards indicate that the density of picnic units should approximate 10 units per acre of developable land and camp units about 4 units per acre of developable land. Boat ramps and associated parking areas were sized for a balanced boating facility, the total size of which was determined by the amount of developable land available.

Access roads were aligned from what appeared to be suitable topography for road location. Concession areas were placed so as to adequately serve recreationists visiting the area. Specific areas for swimming beaches and other specialized uses were not identified but are included in development cost estimates as these will have a bearing on the recreation attraction of the reservoirs.

Recreation Land Requirements

Proposed acquisition lines were drawn around each of the reservoir areas to provide for a logical and usable recreation complex. All of the areas planned for recreation use, with the exception of exterior recreation access roads, are included within the take lines. In addition to lands needed specifically for recreation, it will be necessary to obtain a control strip completely surroundin the reservoir perimeter. This strip is for the purpose of insuring adequate control of the reservoir surface and recreation areas. Land requirements for this control strip are not absolute. On State Water Facilities, 300-500 feet is acquired for this purpose. In administration of the Davis-Grunsky Act, the State requires a minimum control strip of 100 feet measured horizontally from the normal pool perimeter.

Land area measurements were taken from either the reservoir area-capacity curves or were planimetered from topographic mapping. Access road rights-of-way outside of the take line are not included in the estimates of land requirements. It is assumed that exterior access will be provided as a portion of project construction.

Recreation Area Capacities

The daily capacity of a recreation area is defined as the level of recreation use which the area can safely support and is determined by the number and types of units provided. The number of units is applied against an average number of people per party and a turnover rate to represent reuse of a single facility during any one day. A dual-use factor was also applied to boating in areas where it appeared that boaters would be simultaneously occupying road access picnic and boating facilities. The degree of overlap is estimated on the basis of the number of boat access picnic facilities available. Factors used to estimate daily capacity are summarized in Table 2.

TABLE 2

FACTORS USED IN DETERMINING
DAILY RECREATION CAPACITY
COASTAL SAN MATEO COUNTY INVESTIGATION

Type of Unit	Unit of Measurement	People/Party	Parties/Day	Dual Use
Camp	Unit	4.0	1.0	--
Picnic (road access)	Unit	4.0	2.0	--
Boating	Square feet of parking	3.5	2.0	75-85%[1/]

1/ Not applicable on all reservoirs studied.

It should be noted that no capacity is estimated for "boat access only" picnic facilities. The capacity of these units is regulated by the boat area capacities.

Annual capacity is based upon the daily capacity and the estimated length of the recreation season. Potential annual use is based upon a percentage of annual area capacity. The season length and percentage of full capacity use was derived from data from various state parks in the coastal San Mateo area. These estimates are summarized in Table 3.

TABLE 3

FACTORS USED IN DETERMINING ANNUAL
RECREATION CAPACITY AND POTENTIAL USE
COASTAL SAN MATEO COUNTY INVESTIGATION

Type of Activity	Length of Season	Potential Annual Use 1/
Picnicking	160 days	50% of capacity
Camping	90 days	80% of capacity
Boating	160 days	80% of capacity

1/ The percentage of capacity use will probably vary to some extent, e.g. at Denniston Reservoir, where only picnic and boating facilities are planned, it is expected that 50% capacity use will apply to both picnic and boating facilities.

Anticipated Recreation Use

The pattern of recreation demand in this area indicates that the potential reservoirs would probably be used to capacity within a few years of construction. It is assumed that each of the reservoir areas would reach capacity use within ten years of reservoir constru tion and that the buildup to capacity will approximate a straight line.

he total or gross recreation use is determined as outlined above. et recreation use, attributable to project construction, is determined by deducting recreation use which would have occurred without eservoir construction from the gross use estimate. Net visitor ays should be used in determining recreation benefits.

ecreation Costs

ecreation development costs are based upon standard unit costs eveloped by the Recreation Contract Services Unit, Division of eaches and Parks.

TABLE 4

RECREATION UNIT COSTS
COASTAL SAN MATEO COUNTY INVESTIGATION

Unit	Unit Costs
Picnic units, road access	$ 2,700.00
Picnic units, boat access	$ 500.00
Camp units	$ 3,000.00
Access roads (asphalt)	$ 2.75 per sq. yd.
Boat launching ramps, concrete	$ 4.50 per sq. yd.
Launching ramp parking	$ 2.00 per sq. yd.
Sanitary facilities at ramps	$12,000.00 each
Beach improvement	$20,000.00 per acre
Landscaping	$ 3,000.00 per acre

An engineering and contingency estimate of 15 percent, and an escalation estimate of 10 percent were applied to the actual recreation unit costs to obtain a total cost for the construction of recreation facilities. Recreation land costs were added to the facility costs to obtain a total capital cost for recreation development. Recreation operation and maintenance costs were estimated on the basis of $.25 per visitor day. Annual replacement costs are based upon 3-1/2 percent of the total capital investment in recreation facilities. (The basis for annual replacement costs do not include land costs, engineering and contingency, or escalation

It should be noted that costs of stocking fish are not included in the cost estimates. A significant, but undetermined, portion of the predicted recreation use is predicated on the provision of a fishery. The costs of providing fishing will depend upon the nature of the reservoirs and the method employed in establishing the fishery.

Relationship of Water Development Projects to State Park Areas

The relationship of the proposed reservoirs to existing and planne state parks is reported in the reconnaissance. Of the reservoirs presently being considered, only Worley Flat would have a direct adverse affect on a state park. This proposed reservoir would inundate a portion of Portola State Park. It is anticipated that the agency planning to develop the reservoir would have to negotia with the State Department of Parks and Recreation and the State Park Commission in order to construct a reservoir at the Worley Fl site. The department has expressed its opposition to the Worley Flat Project in transmitting the earlier reconnaissance report.

The proposed acquisition take line for the Pigeon Point Project impinges to some extent on the boundaries of Butano State Park. However, none of the park area would actually be inundated. The other reservoirs investigated would have little direct effect upon the California State Park System. Full recreation development of the reservoirs constructed would enhance the general recreation potential of the coastal San Mateo area.

RESERVOIR SITES CONSIDERED

Denniston Reservoir Site

The Denniston Reservoir site is located about 6/10 of a mile northeast of the Half Moon Bay Airport. Access to the site is by unimproved, private ranch road. The proposed damsite is located at the upper end of a small irrigation impoundment on Denniston Creek. The physical characteristics of the reservoir studied are summarized in Table 5.

TABLE 5

PHYSICAL CHARACTERISTICS
DENNISTON RESERVOIR

Water Surface Elevation (feet M.S.L.)	Surface Area (acres)	Storage (acre-feet)	Shoreline Perimeter (miles)
normal pool-250	125	7,000	3.6
minimum pool-175	38	1,100	1.6

Slopes on either side of the reservoir are steep. Some relatively level areas are located at the upper end and above the proposed normal pool elevation. Tree cover is lacking. The north-facing slopes support stands of coastal chaparral. The ridge tops and south-facing slopes are more open and support annual grasses with scattered patches of chaparral.

The lack of vegetative cover could be rectified by adequate landscaping, but the steepness of terrain would make recreation development difficult and costly. Areas which would be suitable for development are for the most part very small and inaccessible, or are located at the upper end of the reservoir where fluctuations in wat surface would prevent year-around use.

The difficulty of developing recreation at the proposed Denniston Reservoir site is reflected in the recreation land use plan, Plate Automobile access is provided to only one small developable area on the south side of the reservoir. This area would be suitable for day use boating and picnicking. Two other areas could be developed for boat access day use. Swimming beaches could be developed in conjunction with the boat access areas. The terrain fronting on the reservoir in the area accessible by automobile is too steep to develop for swimming use.

Access to the recreation area would be furnished by a recreation access road.

The following tabular presentation of recreation development and use data is largely self-explanatory and is based on the criteria outlined in the first portion of this report.

TABLE 6

LAND ACQUISITION REQUIREMENTS
DENNISTON RESERVOIR

Purpose	Proposed Acquisition (acres)
Reservoir	130
Recreation	22[1]
Control Strip	153
Total	305

[1] Does not include recreation access road right-of-way.

TABLE 7

RECREATION AREA CAPACITY
POTENTIAL ANNUAL USE
DENNISTON RESERVOIR

AILY CAPACITY

umber and type	People per party	Turnover	Visitor days per day
5 picnic units (road access)	4.0	2.0	120
0 car and boat railer spaces	3.5	2.0	420
Total Daily Capacity			540

OTENTIAL ANNUAL USE

All facilities for day use only (picnic oriented)	Visitor days per year
540 visitor days per day	
160 day season	
50% average of full capacity use	
Potential Annual Use at Capacity	43,200

TABLE 8

ESTIMATED RECREATION USE WITH PROJECT
DENNISTON RESERVOIR

Year	Recreation Use With Project[1] Visitor Days	Net Recreation Use[2] Visitor Days
1	4,300	4,300
2	8,600	8,600
3	12,900	12,900
4	17,200	17,200
5	21,500	21,500
6	25,800	25,800
7	30,100	30,100
8	34,400	34,400
9	38,700	38,700
10	43,200	43,200
20	43,200	43,200
30	43,200	43,200
40	43,200	43,200
50	43,200	43,200

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[1] All visitor days for day use

[2] No recreation use is expected to occur without project construction.

TABLE 9

CAPITAL COSTS
RECREATION DEVELOPMENT
DENNISTON RESERVOIR

Facility	Unit Cost	Cost
15 Picnic Units (Road Access)	$ 2,700.00/unit	$ 40,500.00
40 Picnic Units (Boat Access)	500.00/unit	20,000.00
Access Road (18,555 Sq. Yds.)	2.75/Sq.Yd.	51,026.00
Beach Improvement (1 acre)	20,000.00/acre	20,000.00
Landscaping (2 acres)	3,000.00/acre	6,000.00
1 Boat Launching Ramp (4,000 Sq. Yds.)	4.50/Sq.Yd.	18,000.00
Parking for Ramp and Road Access Picnic (4,450 Sq. Yds.)	4.00/Sq.Yd.	8,900.00
SUBTOTAL		$164,426.00
15% Engineering and Contingency		24,663.00
10% Escalation		16,442.00
Total for Recreation Facilities		$205,531.00
Land Cost (22 Acres)	$ 500.00/acre	11,000.00
		$216,531.00
		or
GRAND TOTAL		$216,500.00

TABLE 10

ANNUAL COSTS[1]

OPERATION, MAINTENANCE AND REPLACEMENT
DENNISTON RESERVOIR

Year	Visitor days	Operation & maintenance @25¢/ visitor day	Replacement[2] @3-1/2% capital inv.	Total O.M.&R.
1	4,300	$ 1,075	$5,755	$ 6,830
2	8,600	2,150	5,755	7,905
3	12,900	3,225	5,755	8,980
4	17,200	4,300	5,755	10,055
5	21,500	5,375	5,755	11,130
6	25,800	6,450	5,755	12,205
7	30,100	7,525	5,755	13,280
8	34,400	8,600	5,755	14,355
9	38,700	9,675	5,755	15,430
10	43,200	10,800	5,755	16,555
20	43,200	10,800	5,755	16,555
30	43,200	10,800	5,755	16,555
40	43,200	10,800	5,755	16,555
50	43,200	10,800	5,755	16,555

1/ Not present worth

2/ Assuming completion of ultimate recreation development in year "1" of operation.

ower Purisima Reservoir Site

he Lower Purisima Reservoir site is located five miles south of alf Moon Bay and 8/10 of a mile east of State Highway 1. Access o the site is by improved county road, the Purisima Creek Road. he damsite is located in the lower portion of the Purisima Creek anyon overlooking the coastal terraces. The physical characteris- ics of the proposed reservoir are summarized in Table 11.

TABLE 11

PHYSICAL CHARACTERISTICS
LOWER PURISIMA RESERVOIR

ater Surface Elevation (Feet, M.S.L.)	Surface Area (acres)	Storage (acre-feet)	Shoreline Perimeter (miles)
normal pool-330	250	17,700	7.9
minimum pool-250	100	3,400	3.6

he Lower Purisima Reservoir site has considerably more potential or recreation development than does the Denniston Creek site. lopes surrounding the reservoir are moderately steep and areas ith adequate vegetative cover are scant. However, the areas uitable for recreation development are larger and more accessible han those available at Denniston Creek.

s indicated on Plate D3,the recreation development plan proposes icnic facilities on several areas surrounding the reservoir. wimming beaches would be constructed in conjunction with the icnic areas. There is an insufficient area available adjacent o the water surface to provide a conventional boat launching amp and parking area. Consequently, it is proposed that boat launching facilities consisting of some sort of tramway or crane, would be constructed by a concessionaire in the area indicated for concession use.

Access to the proposed recreation areas would be furnished by a relocated Purisima Creek county road serving the areas on the north of the reservoir. A recreation access road would be constructed specifically to serve the recreation areas on the south and east.

The tabular presentation which follows summarizes the land requirements, recreation area capacity, estimated recreation use, and recreation costs associated with recreation development of Lower Purisima Reservoir.

TABLE 12

LAND ACQUISITION REQUIREMENTS
LOWER PURISIMA RESERVOIR

Purpose	Proposed Acquisition (acres)
Reservoir	260
Recreation	288[1]
Control strip	342
Total	890

[1] Does not include recreation access road right-of-way.

TABLE 13

RECREATION AREA CAPACITY
POTENTIAL ANNUAL USE
LOWER PURISIMA RESERVOIR

ILY CAPACITY

mber and Type	People per Party	Turnover	Visitor days per day
00 picnic units (road access)	4.0	2.0	4,000
Total Daily Capacity			4,000

OTENTIAL ANNUAL USE

ll facilities for day use only	Visitor days per year
,000 visitor days per day 60 day season 0% average of full capacity use	
Potential Annual Use at Capacity	320,000

TABLE 14

ESTIMATED RECREATION USE WITH PROJECT LOWER PURISIMA RESERVOIR

Year	Recreation Use[1] With Project Visitor Days	Net Recreation Use[2] Visitor Days
1	32,000	32,000
2	64,000	64,000
3	96,000	96,000
4	128,000	128,000
5	160,000	160,000
6	192,000	192,000
7	224,000	224,000
8	256,000	256,000
9	288,000	288,000
10	320,000	320,000
20	320,000	320,000
30	320,000	320,000
40	320,000	320,000
50	320,000	320,000

[1] All visitor days for day use.

[2] No recreation use is expected to occur without project construction.

TABLE 15

CAPITAL COSTS
RECREATION DEVELOPMENT
LOWER PURISIMA RESERVOIR

Facility	Unit Cost	Cost
0 Picnic Units (Road Access)	$ 2,700.00/unit	$1,350,000.00
cess Roads (90,700 Sq. Yds.)	$ 2.75/Sq.Yd.	249,425.00
ach Improvement (4½ Acres)	$20,000.00/acre	90,000.00
ndscaping (12 acres)	$ 3,000.00/acre	36,000.00
SUBTOTAL		$1,725,425.00
15% Engineering and Contingency		258,814.00
10% Escalation		172,543.00
Total for Recreation Facilities		$2,156,782.00
and Cost (288 Acres)	$ 400.00/acre	115,200,000
GRAND TOTAL		$2,271,982.00
		or
		$2,272,000.00

TABLE 16

ANNUAL COSTS[1]

OPERATION, MAINTENANCE AND REPLACEMENT LOWER PURISIMA RESERVOIR

Year	Visitor days	Operation & maintenance @25¢/ visitor day	Replacement[2] @3-1/2% capital inv.	Total O.M.&R.
1	32,000	$ 8,000	$60,000	$ 68,390
2	64,000	16,000	60,390	76,390
3	96,000	24,000	60,390	84,390
4	128,000	32,000	60,390	92,390
5	160,000	40,000	60,390	100,390
6	192,000	48,000	60,390	108,390
7	224,000	56,000	60,390	116,390
8	256,000	64,000	60,390	124,390
9	288,000	72,000	60,390	132,390
10	320,000	80,000	60,390	140,390
20	320,000	80,000	60,390	140,390
30	320,000	80,000	60,390	140,390
40	320,000	80,000	60,390	140,390
50	320,000	80,000	60,390	140,390

1/ Not present worth.

2/ Assuming completion of ultimate recreation development in year "1" of operation.

Worley Flat Reservoir Site

The Worley Flat Reservoir is located on Pescadero Creek about 25 miles south of Half Moon Bay and 6 miles east of the community of Pescadero. The damsite is about 6/10 of a mile upstream from the San Mateo County Memorial Park. The reservoir would back water nearly 5 miles up Pescadero Creek and into Portola State Park. The physical characteristics of the reservoir studied are summarized in Table 17.

TABLE 17

PHYSICAL CHARACTERISTICS
WORLEY FLAT RESERVOIR

Water Surface Elevation (Feet, M.S.L.)	Surface Area (acres)	Storage (acre-feet)	Shoreline Perimeter (miles)
Normal pool-375	400	25,500	13.3
Minimum pool-280	100	3,500	6.6

Slopes surrounding the proposed reservoir are generally steep. This is especially true of the areas in the downstream portions of the proposed reservoir. The Pescadero Creek Canyon tends to open to some extent in the mid-portions of the reservoir and again narrow toward the upper end of the reservoir. The canyon area is densely wooded with redwood and Douglasfir. The tree cover tends to thin away from the canyon and the redwood and Douglasfir characteristic of the canyon gives way to grass and woodlands on the upper ridges. Much of the harvestable timber has been logged or is in the process of being logged.

The Pescadero Creek area presents an attractive setting for recreation activities and, of the reservoir sites considered, supports the heaviest current recreation use. Current use of the area which would be affected by reservoir construction is estimated at 91,000 visitor days. Included within this estimate are stream fishermen, organization campers, hikers, summer home owners, and a portion of the visitors at Portola State Park. A portion of the developed state park facilities would be directly affected by the proposed reservoir. The effect of vegetative clearing, necessitated by reservoir construction, on the overall character of Portola State Park was not evaluated. Estimates of numbers of stream fishermen are based on fish stocking rates. Estimates of other users are based upon general observations of the facilities affected. The estimated current use of the Worley Flat Reservoir area is summarized in Table 18.

TABLE 18

ESTIMATED CURRENT RECREATION USE
WORLEY FLAT RESERVOIR

Type of users	Visitor days per year
Fishermen	48,000[1]
Portola State Park Visitors	33,000
Others	10,000
TOTAL	91,000

[1] Actually, Pescadero Creek supports about 95,000 angler days per year. However, not all of these fishermen utilize the area which would be inundated by the reservoir. Also, the 95,000 visitor days of angling use includes a portion of the visitors to Portola State Park. Existing recreation use represents both overnight and day use. For purposes of this study it was assumed that the Portola State Park visitors represent the overnight (camp) use, about 36% of the total current recreation use.

The amount of recreation use will tend to increase to some extent without construction of the reservoir project. The rate of increase will be dependent upon a number of unknowns: increased organization camp use, increased fish planting, increased access and summer home development and other factors. For purposes of this study, it was assumed that the use of Pescadero Creek Canyon would increase at a constant rate of 5,000 visitor days per year. This assumption pre-supposes orderly continuing development of the recreation potential of Pescadero Creek.

There is probably a relationship between the capital costs and operation, maintenance, and replacement cost with project and those which would be incurred in supporting the use predicted without project. The degree of relationship was not analyzed for purposes of this report.

Worley Flat Reservoir would be developed for both overnight and day use. Plate D4, Worley Flat Land Use Plan, indicates that these uses would be separated by locating the day use areas north of the reservoir and the camp areas to the south. Access would be provided to the day use, concession and boat launching area by improving one of the existing roads to Camp Pomponio. Access to the camping areas would be from the Portola State Park on an improved, existing San Mateo County fire road.

All of the areas planned for development are located toward the upper end of the reservoir. Terrain elsewhere around the reservoir perimeter is too steep for recreation use. The following tabular presentation summarizes the land requirements, recreation area capacity, estimated recreation use, and recreation cost associated with the recreation development of Worley Flat Reservoir.

TABLE 19

LAND ACQUISITION REQUIREMENTS
WORLEY FLAT RESERVOIR

Purpose	Proposed Acquisition (acres)
Reservoir	410
Recreation	186[1]
Control strip	519
	1,115

[1] Does not include recreation access road right-of-way.

TABLE 20

RECREATION AREA CAPACITY
WORLEY FLAT RESERVOIR

DAILY CAPACITY

Number and type	People per party	Turnover	Dual use[1]	Visitor days per day
250 picnic units (road access)	4.0	2.0	-	2,000
300 camp units	4.0	1.0	-	1,200
147 car and boat trailer spaces	3.5	2.0	75%	775
Total daily capacity				3,975

POTENTIAL ANNUAL USE

Activity	Daily capacity	Season length	Average capacity use	Visitor per y
Picnicking	2,000	160	50%	160,0
Camping	1,200	90	80%	86,4
Boating	775	160	80%	99,2
Potential annual use at capacity				345,6

[1] A dual use factor is applied to represent boaters who will simultaneously occupy road access picnic units.

TABLE 21

ESTIMATED USE WITHOUT PROJECT WORLEY FLAT RESERVOIR

Year	Day use visitor days (64%)1/	Camping use visitor days (36%)1/	Total use visitor days
1	58,200	32,800	91,000
2	61,400	34,600	96,000
3	64,600	36,400	101,000
4	67,800	38,200	106,000
5	71,000	40,000	111,000
6	74,200	41,800	116,000
7	77,400	43,600	121,000
8	80,600	45,400	126,000
9	83,800	47,200	131,000
10	87,000	49,000	136,000
20	119,000	67,000	186,000
30	151,000	85,000	236,000
40	183,000	103,000	286,000
50	215,000	121,000	336,000

1/ Split between day use and camping use on the basis of existing use. Park users assumed to represent campers.

TABLE 22

ESTIMATED GROSS RECREATION USE WITH PROJECT WORLEY FLAT RESERVOIR

Year	Day use visitor days (75%)1/	Camping use visitor days (25%)1/	Total use visitor days
1	25,900	8,700	34,600
2	51,800	17,300	69,100
3	77,800	25,900	103,700
4	103,600	34,600	138,200
5	129,600	43,200	172,800
6	155,500	51,900	207,400
7	181,400	60,500	241,900
8	207,400	69,100	276,500
9	233,200	77,800	311,000
10	259,200	86,400	345,600
20	259,200	86,400	345,600
30	259,200	86,400	345,600
40	259,200	86,400	345,600
50	259,200	86,400	345,600

1/ Split between day use and camping use based on annual use at capacity (see Table 20).

TABLE 23

ESTIMATED NET RECREATION USE - VISITOR DAYS
WORLEY FLAT RESERVOIR

Year	Gross recreation use with project[1]		Total recreation use without project[2]		Net recreation use	
	Day use	Camping	Day use	Camping	Day use	Camping
1	25,900	8,700	58,200	32,800	(-)32,300	(-)24,100
2	51,800	17,300	61,400	34,600	(-) 9,600	(-)17,300
3	77,800	25,900	64,600	36,400	13,200	(-)10,500
4	103,600	34,600	67,800	38,200	35,800	(-) 3,600
5	129,600	43,200	71,000	40,000	58,600	3,200
6	155,500	51,900	74,200	41,800	81,300	10,100
7	181,400	60,500	77,400	43,600	104,000	16,900
8	207,400	69,100	80,600	45,400	126,800	23,700
9	233,200	77,800	83,800	47,200	149,400	30,600
10	259,200	86,400	87,000	49,000	172,200	37,400
20	259,200	86,400	119,000	67,000	140,200	19,400
30	259,200	86,400	151,000	85,000	108,200	1,400
40	259,200	86,400	183,000	103,000	76,200	(-) 16,600
50	259,200	86,400	215,000	121,000	44,200	(-) 34,600

[1] From Table 22

[2] From Table 21

TABLE 24

CAPITAL COSTS
RECREATION DEVELOPMENT
WORLEY FLAT RESERVOIR

Facility	Unit cost	Cost
250 Picnic Units (Road Access)	$ 2,700.00/unit	$ 675,000.00
300 Camp Units	$ 3,000.00/unit	900,000.00
Access Roads (91,733 Sq. Yds.)	$ 2.75/Sq.Yd.	252,265.00
Beach Improvement (6½ acres)	$20,000.00/acre	130,000.00
Landscaping (15 acres)	$ 3,000.00/acre	45,000.00
Boat Launching Ramp (4,000 Sq. Yds.)	$ 4.50/Sq.Yd.	18,000.00
Ramp Parking (9,800 Sq. Yds.)	$ 2.00/Sq.Yd.	19,600.00
SUBTOTAL		$2,039,865.00
15% Engineering and Contingency		305,980.00
10% Escalation		203,986.00
Total for Recreation Facilities		$2,549,831.00
Land Cost (186 acres)	$ 500.00/acre	93,000.00
		$2,642,831.00
		or
GRAND TOTAL		$2,643,000.00

TABLE 25

ANNUAL COSTS[1]

OPERATION, MAINTENANCE AND REPLACEMENT
WORLEY FLAT RESERVOIR

Year	Visitor days	Operation & maintenance @25¢ visitor day	Replacement[2] @3-1/2% capital Inv.	Total O.M.&R.
1	34,600	$ 8 650	$71,400	$ 80 050
2	69 100	17,275	71 400	88,675
3	103,700	25,925	71,400	97,325
4	138 200	34,550	71,400	105,950
5	172,800	43,200	71,400	114,600
6	207,400	51,850	71,400	123,250
7	241,900	60,475	71,400	131,875
8	276,500	69,125	71,400	140,525
9	311,000	77,750	71,400	149,150
10	345,600	86,400	71,400	157,800
20	345,600	86,400	71,400	157,800
30	345,600	86,400	71,400	157,800
40	345,600	86,400	71,400	157,800
50	345,600	86,400	71,400	157,800

[1] Not present worth.

[2] Assuming completion of ultimate recreation development in year "1" of operation.

The Pigeon Point Project

The Pigeon Point Project would consist of two reservoirs, Gazos and Bean Hollow. These two reservoirs would be connected by a channel. The project is located on the Arroyo de los Frijoles and on Gazos Creek, approximately 6 miles south of Pescadero. Access to the site is by the Cloverdale Road. The physical characteristics of the proposed project are summarized in Table 26.

TABLE 26

PHYSICAL CHARACTERISTICS
PIGEON POINT PROJECT
BEAN HOLLOW AND GAZOS RESERVOIRS

Water Surface Elevation (Feet, M.S.L.)	Surface Area (acres)	Storage (acre-feet)	Shoreline Perimeter (miles)
Normal pool-260	1,300	98,400	27.5
Minimum pool (Bean Hollow)-160	190	8,700	7.2
Minimum pool (Gazos) -200	310	19,000	9.4

The two reservoirs making up the project present slightly differen problems in recreation planning. The Gazos Creek Canyon is a precipitously steep V-shaped canyon. The canyon does, however, tend to widen above the junction of the existing Cloverdale and Gazos Creek roads. In this area there are benches which would be suitab for recreation development. Vegetative cover surrounding the Gazo Reservoir site consists of logged over and second growth Douglasfi and redwood. Cover in the canyon is dense, but tends to thin near the ridgetops.

The Bean Hollow Reservoir site is located in a rather broad U-shaped canyon. While slopes are not as steep as those in the Gazos watershed, terrain still acts as a barrier to full recreation development. Areas suitable for recreation development are large but access to these areas is difficult. Vegetative cover is scant. The west and south-facing slopes are grass covered. The north-facing slopes support some patches of coastal chaparral and a few deciduous trees.

The Gazos Creek watershed receives some recreation use at the present time. This use consists of fishing sustained by a trout planting program. It is estimated that Gazos Creek, in the area of the reservoir, supports approximately 500 angler days of use annually. This use is expected to increase slightly in future years.

The recreation land use plan developed for the Pigeon Point Project, late D5, indicates that the area could be developed for a variety f recreation activities. Both overnight and day use activities ould be accommodated on both reservoirs. Boat launching ramps re included on both reservoirs to insure usability of the reseroirs at low water stages. Some of the prospective picnic units ould be developed for boat access only. Most of the picnic units ould, however, be accessible by road. Four major access points ould be provided. Two recreation access roads would connect with relocated Cloverdale County Road. A third access road, to serve he areas on the north and northeast side of Bean Hollow Reservoir, ould connect with the old alignment of the coast highway which s now maintained as a county road. A fourth access road would onnect with the existing Coast Highway south of Gazos Creek and would serve the recreation areas on the southern portion of Gazos Reservoir.

The following tabular presentation of recreation development and use data is largely self-explanatory and is based on the criteria outlined in the first portion of this report.

TABLE 27

LAND ACQUISITION REQUIREMENTS
PIGEON POINT PROJECT

Purpose	Proposed acquisition (acres)
Reservoirs	1,500
Recreation	432[1]
Control Strip	1,125
Total	3,057

[1] Does not include recreation access road right-of-way.

TABLE 28

RECREATION AREA CAPACITY
PIGEON POINT PROJECT

DAILY CAPACITY

Number and type	People per party	Turnover	Dual[1/] use	Visitor days per day
970 Picnic Units (road access)	4.0	2.0	---	7,760
400 Camp Units	4.0	1.0	---	1,600
225 Car and Boat Trailer Spaces	3.5	2.0	75%	1,180
Total Daily Capacity				10,540

POTENTIAL ANNUAL USE

Activity	Daily capacity	Season length	Average capacity use	Visitor days per year
Picnicking	7,760	160	50%	620,800
Camping	1,600	90	80%	115,200
Boating	1,180	160	80%	151,000
Potential Annual Use at Capacity				887,000

[1/] A dual use factor is applied to represent boaters who will simultaneously occupy road access picnic units.

TABLE 29

ESTIMATED USE WITHOUT PROJECT
PIGEON POINT PROJECT

Year	Total use without project[1]
1	500
2	517
3	534
4	551
5	568
6	585
7	602
8	619
9	636
10	653
20	823
30	993
40	1,163
50	1,333

[1] All existing use consists of day use angling--projected on the basis of increases in angling license sales.

TABLE 30

ESTIMATED GROSS RECREATION USE
WITH PROJECT
PIGEON POINT PROJECT

Year	Day use visitor days (87%)1/	Camp use visitor days (13%)1/	Total use visitor days
1	77,200	11,500	88,700
2	154,400	23,000	177,400
3	231,600	34,500	266,100
4	308,700	46,100	354,800
5	385,900	57,600	443,500
6	463,100	69,100	532,200
7	540,300	80,600	620,900
8	617,500	92,100	709,600
9	694,600	103,700	798,300
10	771,800	115,200	887,000
20	771,800	115,200	887,000
30	771,800	115,200	887,000
40	771,800	115,200	887,000
50	771,800	115,200	887,000

1/ Split between day use and camping based on annual use at capacity (see Table 28).

TABLE 31

ESTIMATED NET RECREATION USE - VISITOR DAYS
PIGEON POINT PROJECT

	Gross recreation use with project1/		Total recreation use without project2/	Net recreation use	
Year	Day use	Camp use	Day use only	Day use	Camp use
1	77,200	11,500	500	76,700	11,500
2	154,400	23,000	517	153,900	23,000
3	231,600	34,500	534	231,100	34,500
4	308,700	46,100	551	308,100	46,100
5	385,900	57,600	568	385,300	57,600
6	463,100	69,100	585	462,500	69,100
7	540,300	80,600	602	539,700	80,600
8	617,500	92,100	619	616,900	92,100
9	694,600	103,700	636	694,000	103,700
10	771,800	115,200	653	771,100	115,200
20	771,800	115,200	823	771,000	115,200
30	771,800	115,200	993	770,800	115,200
40	771,800	115,200	1,163	770,600	115,200
50	771,800	115,200	1,333	770,500	115,200

1/ From Table 30

2/ From Table 29

TABLE 32

CAPITAL COSTS
RECREATION DEVELOPMENT
PIGEON POINT PROJECT

Facility	Unit cost	Cost
90 Picnic Units (Road Access)	$ 2,700.00/unit	$2,619,000.00
10 Picnic Units (Boat Access)	$ 500.00/unit	65,000.00
40 Camp Units	$ 3,000.00/unit	1,200,000.00
cess Roads (57,100 Sq.Yds.)	$ 2.75/Sq.Yd.	157,025.00
ach Improvement (3½ acres)	$20,000.00/acre	70,000.00
ndscaping (28 acres)	$ 3,000.00/acre	84,000.00
at Launching Ramps (7,250 Sq.Yds.)	$ 4.50/Sq.Yd.	32,625.00
mp Parking (15,000 Sq.Yds.)	$ 2.00/Sq.Yd.	30,000.00
Rest Rooms at Ramps	$12,000.00/Each	48,000.00
Subtotal		$4,305,650.00
15% Engineering and Contingency		645,848.00
10% Escalation		430,565.00
Total for Recreation Facilities		$5,382,063.00
and Cost (432 acres)	$500.00/acre	216,000.00
		$5,598,063.00
		or
GRAND TOTAL		$5,598,000.00

TABLE 33

ANNUAL COSTS[1]
OPERATION, MAINTENANCE AND REPLACEMENT
PIGEON POINT PROJECT

Year	Visitor days	Operation & maintenance @25¢/ visitor day	Replacement[2] @3-1/2% capital inv.	Total O.M.&R.
1	88,700	$ 22,175	$150,700	$172,875
2	177,400	44,350	150,700	195,050
3	266,100	66,525	150,700	217,225
4	354,800	88,700	150,700	239,400
5	443,500	110,875	150,700	261,575
6	532,200	133,050	150,700	283,750
7	620,900	155,225	150,700	305,925
8	709,600	177,400	150,700	328,100
9	798,300	199,575	150,700	350,275
10	887,000	221,750	150,700	372,450
20	887,000	221,750	150,700	372,450
30	887,000	221,750	150,700	372,450
40	887,000	221,750	150,700	372,450
50	887,000	221,750	150,700	372,450

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[1] Not present worth.

[2] Assuming completion of ultimate recreation development in year "1" of operation.

TABLE 34
RECREATION AREA CAPACITY
BEAN HOLLOW RESERVOIR
(A Portion of the Pigeon Point Project)

DAILY CAPACITY

Number and Type	People per party	Turnover	Dual[1/] use	Visitor days per day
615 Picnic Units (road access)	4.0	2.0	---	4,920
228 Camp Units	4.0	1.0	---	912
120 Car and Boat Trailer Spaces	3.5	2.0	75%	630
Total Daily Capacity				6,462

POTENTIAL ANNUAL USE

Activity	Daily capacity	Season length	Average capacity use	Visitor days per day
Picnicking	4,920	160	50%	393,600
Camping	912	90	80%	65,700
Boating	630	160	80%	80,600
Potential Annual Use at Capacity				539,900

[1/] A dual use factor is applied to represent boater who will simultaneously occupy road access picnic units.

TABLE 35

ESTIMATED RECREATION USE WITH PROJECT
BEAN HOLLOW RESERVOIR
(A Portion of the Pigeon Point Project)

Year	Day use visitor days	Camp use visitor days	Net use visitor days1/
1	47,400	6,600	54,000
2	94,900	13,100	108,000
3	142,300	19,700	162,000
4	189,700	26,300	216,000
5	237,100	32,900	270,000
6	284,500	39,400	323,900
7	331,800	46,100	377,900
8	379,300	52,600	431,900
9	426,800	59,100	485,900
10	474,200	65,700	539,900
20	474,200	65,700	539,900
30	474,200	65,700	539,900
40	474,200	65,700	539,900
50	474,200	65,700	539,900

1/ The recreation use without project (Table 29 in earlier report) occurs in the area of Gazos Reservoir Site. All visitor days on Bean Hollow Reservoir would be net.

TABLE 36

CAPITAL COSTS
RECREATION DEVELOPMENT
BEAN HOLLOW RESERVOIR
(A Portion of the Pigeon Point Project)

Facility	Unit Cost	Cost
5 Picnic Units (Road Access)	$ 2,700.00/unit	$1,660,500.00
5 Picnic Units (Boat Access)	500.00/unit	57,500.00
28 Camp Units	3,000.00/unit	684,000.00
cess Roads (31,334 Sq.Yds.)	2.75/sq.yd.	86,168.00
ndscaping (20 acres)	3,000.00/acre	60,000.00
at Launching Ramp (3,350 Sq.Yds.)	4.50/sq. yd.	15,075.00
mp Parking (8,000 Sq. Yds.)	2.00/sq. yd.	16,000.00
Rest Rooms at Ramp	12,000.00/each	24,000.00
Subtotal		$2,603,243.00
15% Engineering and Contingency		390,486.00
10% Escalation		260,324.00
Total for Recreation Facilities		$3,254,053.00
nd Cost (266 acres)	500.00/acre	133,000.00
		$3,387,053.00
		or
GRAND TOTAL		$3,387,000.00

TABLE 37

ANNUAL COSTS[1]
OPERATION, MAINTENANCE AND REPLACEMENT
BEAN HOLLOW RESERVOIR
(A Portion of the Pigeon Point Project)

Year	Visitor days	Operation & maintenance @25¢/ visitor day	Replacement[2] @3-1/2% capital inv.	Total O.M.& R.
1	54,000	$ 13,500	$91,125	$104,625
2	108,000	27,000	91,125	118,125
3	162,000	40,500	91,125	131,625
4	216,000	54,000	91,125	144,125
5	270,000	67,500	91,125	158,625
6	323,900	80,975	91,125	172,100
7	377,900	94,475	91,125	185,600
8	431,900	107,975	91,125	199,100
9	485,900	121,475	91,125	212,600
10	539,900	134,975	91,125	226,100
20	539,900	134,975	91,125	226,100
30	539,900	134,975	91,125	226,100
40	539,900	134,975	91,125	226,100
50	539,900	134,975	91,125	226,100

[1] Not present worth

[2] Assuming completion of ultimate recreation development in year "1" of operation.

APPENDIX E

SUMMARY OF ENGINEERING GEOLOGIC CONDITIONS FOR SELECTED DAMSITES

SUMMARY OF ENGINEERING GEOLOGIC CONDITIONS FOR SELECTED DAMSITES

Damsite	Creek	Location No.	Foundation Rock (Adequacy)	Slope Stability (Includes information on landsliding)	Underflow in Channel Section	Reservoir or Abutment Leakage	Construction Materials	Seismic Evaluation	Other
Sites on Consolidated and Competent Rocks									
Denniston	Denniston	2	Quartz diorite strongly decomposed. Very competent as foundation material when fresh. Cretaceous in age	Cut slopes 1.5:1 or higher should be stable unless in area of deep weathering. No landsliding observed at site. Small slides in reservoir area.	Thickness of alluvium in channel section estimated to be 30 feet. Substantial seepage will probably occur unless material removed or blanket or cutoff wall installed.	Reservoir leakage probably minor. Abutment leakage could occur if extensive jointing is present.	Sufficient impervious in reservoir area. Pervious scarce, crushed quartz diorite probably can be used. Decomposed granitics probably highly compressible.	Seismic hazards high. Active Pilarcitos and San Andreas faults within six miles distance.	Silting in the reservoir area will probably be heavy. Relatively good damsite, geologically. Earthfill or rockfill.
Skyline	Pilarcitos	5	Quartz diorite strongly decomposed. Very competent as foundation material when fresh. Cretaceous in age.	Cut slopes 3/4:1 or higher should be stable unless area of deep weathering. No slides detected. Thick sections of slope wash in some minor drainages.	Thickness of alluvium in channel section over 50 feet. Substantial underflow probably will occur unless material excavated or adequate cutoff wall or blanket installed.	Reservoir leakage probably minor. Abutment leakage could occur if extensive jointing is present.	Sufficient impervious in reservoir area or from colluvial deposits. Pervious scarce. Crushed quartz diorite probably can be used. Decomposed granitics probably highly compressible.	Seismic hazards high. Active Pilarcitos and San Andreas faults within 2 miles of site.	Silting in reservoir area will probably be heavy. Possible fault on left abutment. Fairly good site, geologically. Earthfill or rockfill.
Loma Mar No. 1	Pescadero	28	Medium-grained sandstone of the consolidated Butano formation of Eocene age.	Slide of unknown extent on top of left abutment. Otherwise, slopes 1:1 and steeper are probably stable.	Channel section filled with much coarse material of unknown thickness. Considerable underflow could occur unless removed, blanketed, or cutoff wall installed.	Probably minor through reservoir. Abutment leakage probably also minor. However, possibility exists that joint systems and solution channels could exist here.	Sufficient impervious available in reservoir area upstream from axis, from stream terraces. Pervious from processed channel deposits and by crushing quarried Butano formation.	Seismic hazard probably high. Site within one mile of Butano fault and within 9 miles of the active San Andreas fault.	Site almost on axis of Butano anticline. Solution appears to have been active on right abutment. Thickness of fill in channel section unknown. Poor damsite.
Loma Mar No.2	Pescadero	29	Medium-grained sandstone of the consolidated Butano formation of Eocene age.	Slopes in excess of 3/4:1 should be stable. No landslides detected.	Probably stream channel deposits not over 15 feet in thickness and should be removed to prevent underseepage.	Leakage through reservoir will probably be minor. Leakage through abutments will be minor unless joint systems or solution channels detected.	Sufficient impervious in reservoir available in reservoir area upstream. Pervious from processed channel deposits and by crushing quarried Butano formation.	Seismic hazard probably high. Site within one mile of Butano fault and within 9 miles of active San Andreas fault.	Site on south flank of Butano anticline. Strata dipping downstream at steep angle. Saddle spillway, left side. Good damsite.

SUMMARY OF ENGINEERING GEOLOGIC CONDITIONS FOR SELECTED DAMSITES (Continued)

Damsite	Creek	Location No.	Foundation Rock (Adequacy)	Slope Stability (Includes information on landsliding)	Underflow in Channel Section	Reservoir or Abutment Leakage	Construction Materials	Seismic Evaluation	Other
Bean Hollow	Arroyo de los Frijoles	37	Sandstone and conglomerate with some shale. Probably very competent foundation rock. Consolidated Pigeon Point Formation of Cretaceous age.	Cut slopes probably will be stable at 3/4:1 slopes. Two small slides located short distance downstream from axis on right side.	Depth to bedrock in channel section probably over 25 feet. Permeable layers could exist in the alluvial fill to allow excessive underflow. Cutoff wall may be necessary.	Reservoir leakage probably minor. Abutment leakage also probably minor unless open fracture systems found.	Sufficient impervious in reservoir area, but could be excessively wet due to high water table. Pervious can be salvaged from stripping spoils and from crushing Pigeon Point Formation.	Seismic hazard probably moderate. Site approximately two miles from San Gregorio fault and within 14 miles of active Pilarcitos and San Andreas fault.	Reservoir will inundate two existing reservoirs upstream. High water levels in floor of valley. Good damsite geologically. Earthfill or rockfill.
Gazos Creek No. 1 (Downstream Axis)	Gazos	39	Sandstone and pebble conglomerate interbedded with siltstone and shale. Consolidated Pigeon Point Formation of Cretaceous age.	Cut slopes probably will be stable at 1:1 slopes or higher. Minor earth slumps on right abutment and one small slide detected on left side approximately 150 feet upstream from axis.	Depth to bedrock in channel section estimated to reach maximum of 40 feet. Will probably allow substantial underflow unless removed or adequate cutoff wall or blanket installed.	Leakage from reservoir probably will be minor. Minor leakage also probable through abutments unless fracture systems found.	Sufficient impervious probably present in reservoir area. More available from stripping spoils or from marine terraces downstream. Pervious can be salvaged from stripping spoils and from crushing Pigeon Point Formation.	Seismic hazard probably moderate. Site approximately one mile from San Gregorio fault and within 15 miles of active Pilarcitos and San Andreas faults.	Relatively good site geologically. Earthfill or rockfill.
Gazos Creek No. 1 (Upstream Axis)	Gazos	39	Sandstone, pebble conglomerate and siltstone of Pigeon Point Formation of Cretaceous age.	Cut slopes of 1:1 will probably be stable. Small slide immediately above Cloverdale Road on right abutment. Another small slide in left bank of the creek.	Depth to bedrock in channel section estimated to be generally less than 10 faet. Substantial underflow will occur unless excavated or adequate cutoff or blanket installed.	Reservoir leakage probably will be minor. Also, leakage through abutments should be minor unless fracture systems are found.	Sufficient impervious probably present in reservoir araa or in downstream channel section. Pervious from channel section and from stripping spoils, also crushed Pigeon Point Formation.	Seismic hazard probably moderate. Site about one mile from San Gregorio fault and within 15 miles of active Pilarcitos and San Andreas faults.	Good site, geologically. Spillway site better than Gazos No. 1. Earthfill or rockfill.
Whitehouse	Whitehouse	41	Sandstone, siltstones, and diatomoceous siltstones of the Pigeon Point Formation of Cretaceous age.	Cut slopes of 3/4:1 will probably be stable. No sliding detected.	Thickness of alluvial fill approximately 10-15 feet. Substantial underflow will occur unless fill removed or adequate cutoff installed.	Probably minor.	Adequate quantities of impervious in reservoir area within one mile of site. Pervious can probably be obtained by sorting of channel section and alluvial fill materials. May be scarce though.	Seismic hazard probably moderate. Site within 14 miles of active San Andreas fault and less than one mile west of Seal Beach - San Gregorio fault.	Appears to be relatively good site geologically.

SUMMARY OF ENGINEERING GEOLOGIC CONDITIONS FOR SELECTED DAMSITES (Continued)

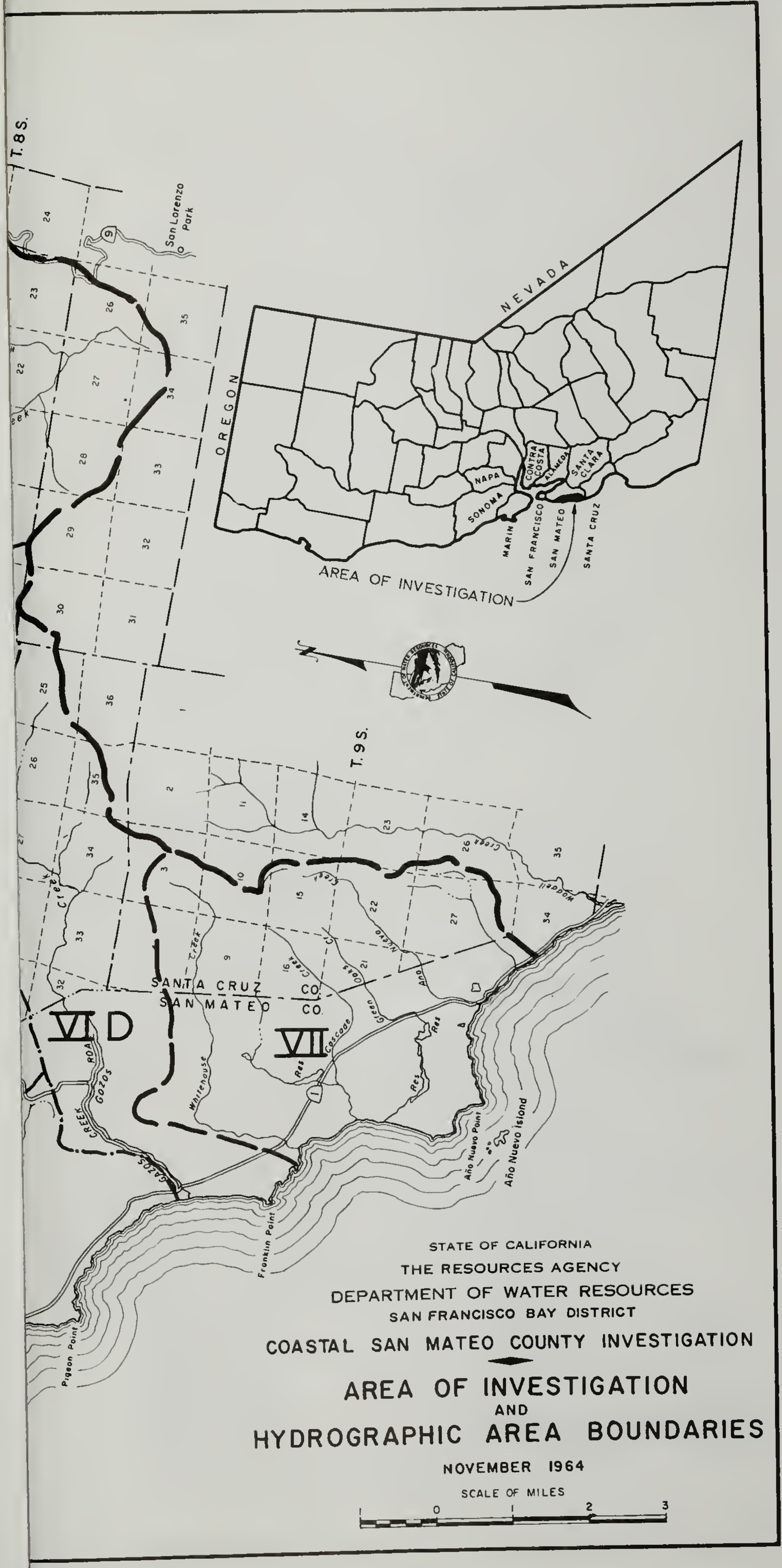
Damsite	Creek	Location No.	Foundation Rock (Adequacy)	Slope Stability (Includes information on landsliding)	Underflow in Channel Section	Reservoir or Abutment Leakage	Construction Materials	Seismic Evaluation	Other
Sites on Structurally Weak Rocks									
Purisima No. 1	Purisima	9	Relatively soft silicious mudstones and siltstones of the Purisima formation of Pliocene age.	Two slides on left side of creek. One slide immediately upstream and the other a short distance downstream from axis. Otherwise slopes appear stable at 1:1 or less.	Thickness of alluvial fill in channel section approximately 30 feet. Substantial underflow will occur unless removed or adequate blanket or cutoff installed.	Some reservoir and abutment leakage may occur, but it will probably be minor.	Sufficient impervious in reservoir area closeby. Pervious scarce. Some may be obtained from sorting spoils from channel section, remainder from crushing Butano sandstone quarried several miles to the east.	Seismic hazard high. Site within 7 miles of active Pilarcitos and San Andreas faults.	Old petroleum operation just downstream from left abutment. Site only conditionally recommended due to local landsliding and seismic hazards together.
Purisima No. 2	Purisima	10	Relatively soft silicious mudstones and siltstones of the Purisima formation of Pliocene Age.	Small slides on left abutment, larger mudflow type in upstream tributary on left side. Two small slides 500-1500 feet upstream on right side of valley.	Thickness of alluvial fill in channel section probably 15-20 feet. Substantial underflow may occur unless removed or adequate blanket or cutoff installed.	Probably minor	Sufficient impervious in reservoir area closeby. Pervious scarce. Some may be obtained by sorting spoils from channel section, remainder from crushing Butano sandstone quarried 1-2 miles to the southeast.	Seismic hazard high. Site within 5.5 miles of active Pilarcitos and San Andreas faults.	Site only conditionally recommended due to local landsliding and seismic hazards.
Lobitos	Lobitos	12	Diatomaceous siltstone and mudstone of the Pliocene Purisima formation.	Small slides on axis on both abutments, large ones 200-300 feet downstream on both abutments.	Thickness of alluvial fill about 2 feet. This fill must be removed to prevent underflow. Some grouting may be required.	Possible leakage through abutments unless slides removed. Some grouting may be necessary.	Landslide materials downstream from axis and alluvial materials in reservoir area within 2 miles can be used for impervious and random fill. Pervious materials scarce, can probably use crushed Butano sandstone on ridges 2-3 miles to the northeast.	Seismic hazard high. Site within 7 miles of active Pilarcitos and San Andreas faults.	Site on southwest limb of Purisima anticline. Site recommended if moved upstream 200 feet.
San Gregorio Creek No.2	San Gregorio	16	Medium-hard siltstone, mudstone of the Purisima formation of Pliocene age.	No slides detected at this site. Slopes 1.5:1 or less stable on right abutment. Much higher slopes appear to be stable on left abutment.	Thickness of alluvial fill estimated to reach a maximum of 20 feet. Substantial underflow will occur unless fill removed or blanket or cutoff installed.	Reservoir and abutment leakage probably will be minor.	Sufficient impervious nearby in reservoir area. Pervious scarce. Some may be obtained from sorting spoils from channel section, remainder may be available from crushed Mindego formation in upper reservoir area.	Seismic hazard high. Site within 10 miles of active Pilarcitos and San Andreas faults.	Reservoir will flood potential petroleum producing areas. Fairly good site geologically.

SUMMARY OF ENGINEERING GEOLOGIC CONDITIONS FOR SELECTED DAMSITES (Continued)

Damsite	Creek	Location No.	Foundation Rock (Adequacy)	Slope Stability (Includes information on landsliding)	Underflow in Channel Section	Reservoir or Abutment Leakage	Construction Materials	Seismic Evaluation	Other
Pescadero	Pescadero	26	Thinly bedded diatomaceous mudstones that have been extensively crushed and broken in places. Considered to be a relatively incompetent rock Monterey formation of Miocene age.	Three slides near axis of dam. A large one 1,000 feet upstream and two smaller ones 500 feet upstream and downstream from axis. Area unstable.	Depth of alluvial fill in channel section over 50 feet. Substantial underflow will occur unless material removed or blanket or cutoff installed.	Leakage through reservoir probably will be minor. Substantial leakage could occur through possible fracture systems in thin ridge forming left abutment.	Sufficient impervious available in reservoir area immediately upstream. Pervious scarce - may be obtained by sorting spoils in channel section or by crushing nearby Butano sandstones.	Seismic hazard. Site-within 12 miles of active San Andreas and Pilarcitos faults.	Site poor, geologically, and so not recommended. Submergence of toe of large slides or earthquakes could cause movement into dam or reservoir. Underlying rock relatively incompetent and thick fill in channel section.
Juanita No. 1	Butano	34	Siltstones, sandstones, and mudstones of the Pliocene Purisima formation.	Most of right abutment may be slide or thick colluvial deposit. Slopes of 1:1 or less appear to be relatively stable.	Broad channel section with maximum thickness of 25 feet of alluvial fill. Will probably allow substantial underflow unless removed or adequate cutoff wall or blanket installed.	Some reservoir leakage may occur; however, major leakage probably will occur through Purisima formation on both abutments.	Sufficient impervious available in reservoir area immediately upstream from site. Some pervious may be sorted from spoils in channel section, remainder must be imported. Quarry about 3 miles downstream.	Seismic hazard probably moderate. Site approximately 12 miles from active Pilarcitos and San Andreas faults.	Possible fault through saddle over left abutment. Headward erosion gullies on right abutment. This site is fairly poor geologically.
Juanita No. 2	Butano	35	Mudstones and sandstones of the Pliocene Purisima formation on the left abutment and lower one-third of the right abutment. The remainder is underlain by silicious mudstones and siltstones of the Miocene Monterey formation.	Two small slides on right abutment. Entire left abutment may be a landslide. Slopes in excess of 1.5:1 are probably unstable in this area.	Alluvial fill in channel section estimated to reach a maximum thickness of 50 feet. If not removed or adequate cutoff or blanket installed, substantial underflow could occur.	Some reservoir leakage may occur; however, major leakage will probably occur through abutments.	Sufficient impervious in reservoir area immediately upstream from site. Some pervious material may be obtained by sorting channel section spoils, remainder can be obtained from quarries on Pigeon Point formation one mile further east.	Seismic hazard high as possible slides could be triggered off even though slide about 13 miles from active Pilarcitos and San Andreas faults. San Gregorio fault about 1/3 way up right abutment; may be a wide zone.	Site not recommended because of fault on right abutment and possible slide forming entire left abutment.
El Oso	Waddel	43	Selicious and diatomaceous siltstone, mudstones, and shales of the Monterey Formation of Miocene age.	Site in very steep canyon. Entire left abutment appears unstable with springs and fractured, saturated ground.	Thickness of alluvial fill estimated to be about 8 feet. Substantial underflow will occur unless fill removed or adequate cutoff installed.	Possible substantial leakage through left abutment unless grouted adequately or other remedial measures taken.	Pervious materials scarce, impervious in limited quantities in reservoir area and may have to explore downstream valley areas.	Seismic hazard probably moderate. Site within 14 miles of active San Andreas fault and 1.5 miles east of Seal Cove-San Gregorio Fault.	Site only conditionally recommended due to unstable and weak left abutment.

SUMMARY OF ENGINEERING GEOLOGIC CONDITIONS FOR SELECTED DAMSITES (Continued)

Damsite	Creek	Location No.	Foundation Rock (Adequacy)	Slope Stability (Includes information on landsliding)	Underflow in Channel Section	Reservoir or Abutment Leakage	Construction Materials	Seismic Evaluation	Other
Sites on Both Consolidated, Competent Rocks and Structurally Weak Rocks									
Worley	Pescadero	30	Right abutment and channel section underlain by sandstone and siltstone of the Pliocene Purisima formation. Lower 2/3 of left abutment underlain by thinly bedded silicious mudstones of the Miocene Monterey formation. The Eocene Butano formation, composed of sandstone underlies the remainder of the left abutment. Bedding vertical or overturned and striking up and downstream.	Possible slide in Worley Flat just upstream from proposed axis on right side. Another possible slide on same side low on abutment. Natural slopes appear to be stable in steep cuts when dry, but seem to fail in vertical sheets when saturated.	Strata underlying the channel section and both abutments strike in a general upstream-downstream direction (the creek has incised meanders in this vicinity) and dip steeply or are vertical. In addition, the Butano fault, with an altitude similar to the bedding, crosses the approximate center of the axis. Substantial movement of ground water could occur through permeable beds along the contact between permeable and impermeable beds, through fracture systems, or through the fault zone. Considerable exploration will probably be necessary to determine where seepage, piping, etc., may occur. Reservoir seepage may occur down dip of Purisima formation.		Sufficient impervious available from stream terrace deposits downstream from axis or from residual soils in reservoir area. Pervious scarce. Sufficient quantities probably can be obtained by crushing Butano formation.	Seismic hazard high. Site within 7 miles of active San Andreas and Pilarcitos faults.	This site is considered a poor site geologically. Considerable exploration work is necessary to justify feasibility of 180 foot dam here.
Butano (Downstream Axis)	Butano	33	Right abutment underlain by fine-grained sandstone of Pliocene Purisima formation and semi-consolidated stream terrace deposits of Quaternary age. Left abutment underlain by consolidated sandstone and conglomerate of Pigeon Point formation of Cretaceous age.	Small slide upstream from right abutment in small drainage. Slopes of 1:1 probably stable on right abutment. On left abutment, slopes of 3/4:1 and greater are probably stable.	Estimated thickness of 35 feet of alluvium underlies channel section. Substantial seepage could occur unless fill removed or adequate cutoff wall or blanket installed.	Substantial leakage may occur through thin right abutment and through abutments of saddle dam between Butano and Pescadero Creek drainage.	Sufficient impervious in reservoir area upstream from dam. Pervious scarce, may be obtained by crushing conglomerate of left abutment and from sorting spillway and channel spoils.	Seismic hazard moderate. Site within 14 miles of active Pilarcitos and San Andreas faults.	Fairly good site geologically. Right abutment thin nose. Two saddle dams needed. Active quarry at top of left abutment.
Butano (Upstream Axis)	Butano	33	Right abutment underlain by relatively soft sandstone and siltstone of Pliocene Purisima formation. Left abutment underlain by hard, consolidated sandstone and conglomerate of Cretaceous Pigeon Point formation.	Small slide downstream from right abutment in small drainage. Slopes of 1.5:1 appear stable on right abutment. Slopes greater than 3/4:1 appear stable on left abutment.	Estimated thickness of 35 feet of alluvium underlie channel section. Substantial underflow could occur unless material removed or adequate cutoff or blanket installed.	Probably some leakage from reservoir. Leakage will also occur through abutments of saddle dam between Butano and Pescadero Creek drainage.	Sufficient impervious in alluvial fill in reservoir area. Pervious scarce, but may be obtained by crushing conglomerate of left abutment or by sorting spoils from channel section.	Seismic hazard moderate. Site within 14 miles of active Pilarcitos and San Andreas faults.	Good site geologically. Saddle dam required.



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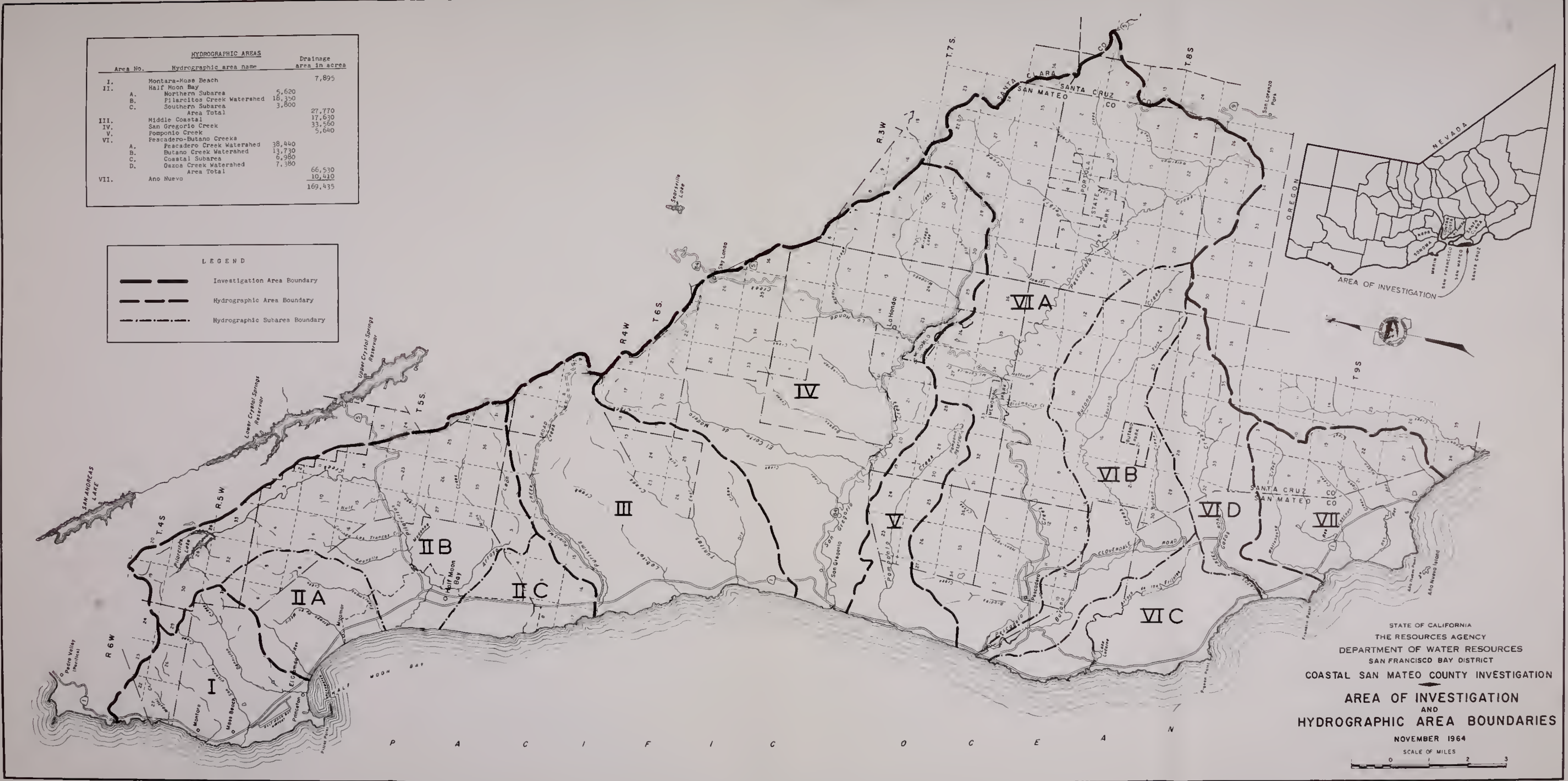
COASTAL SAN MATEO COUNTY INVESTIGATION

AREA OF INVESTIGATION
AND
HYDROGRAPHIC AREA BOUNDARIES

NOVEMBER 1964



HYDROGRAPHIC AREAS

Area No.		Hydrographic area name		Drainage area in acres
I.		Montara-Moss Beach		7,895
II.		Half Moon Bay		
	A.	Northern Subarea	5,620	
	B.	Pilarcitos Creek Watershed	18,350	
	C.	Southern Subarea	3,800	
		Area Total		27,770
III.		Middle Coastal		17,630
IV.		San Gregorio Creek		33,560
V.		Pomponio Creek		5,640
VI.		Pescadero-Butano Creeks		
	A.	Pescadero Creek Watershed	38,440	
	B.	Butano Creek Watershed	13,730	
	C.	Coastal Subarea	6,980	
	D.	Gazos Creek Watershed	7,380	
		Area Total		66,530
VII.		Ano Nuevo		10,410
				169,435

LEGEND

▬ ▬	Investigation Area Boundary
▬ ▬ ▬	Hydrographic Area Boundary
‐·‐·‐·‐	Hydrographic Subarea Boundary

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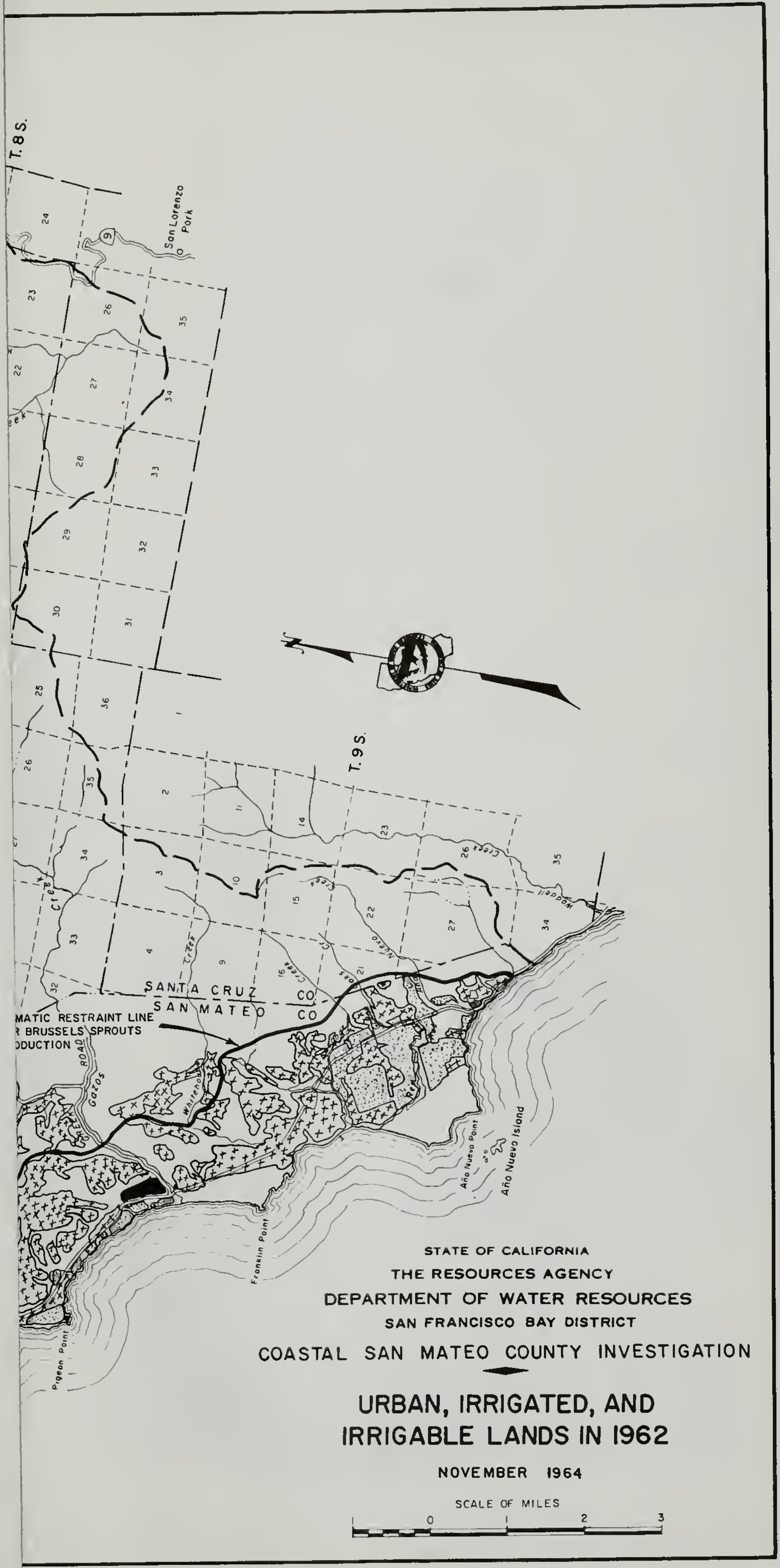
SAN FRANCISCO BAY DISTRICT
COASTAL SAN MATEO COUNTY INVESTIGATION

AREA OF INVESTIGATION AND HYDROGRAPHIC AREA BOUNDARIES

NOVEMBER 1964

PLATE 2



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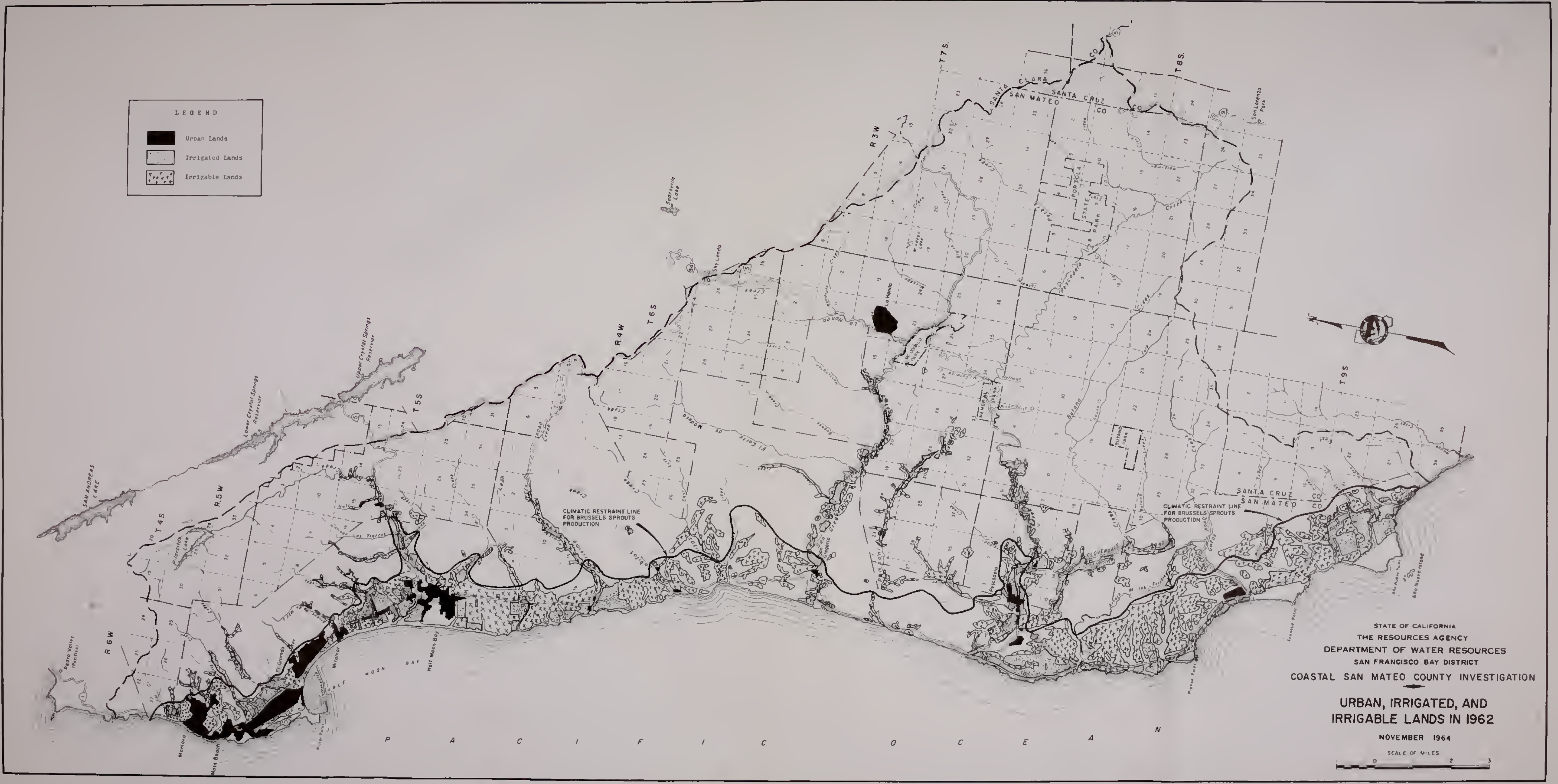
COASTAL SAN MATEO COUNTY INVESTIGATION

URBAN, IRRIGATED, AND IRRIGABLE LANDS IN 1962

NOVEMBER 1964

SCALE OF MILES
0 1 2 3

PLATE 2



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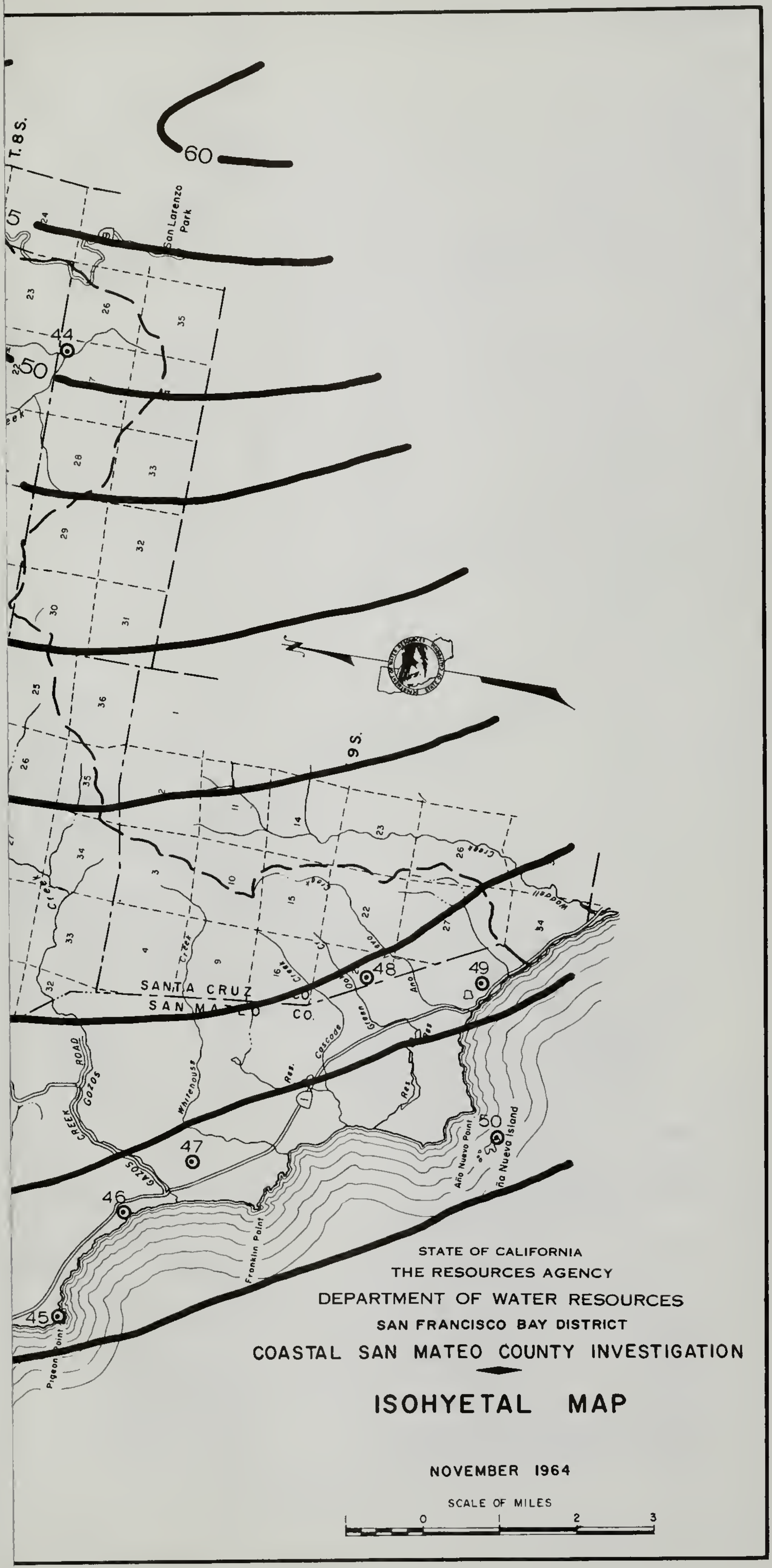
COASTAL SAN MATEO COUNTY INVESTIGATION

URBAN, IRRIGATED, AND IRRIGABLE LANDS IN 1962

NOVEMBER 1964

PLATE 3



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SAN FRANCISCO BAY DISTRICT

COASTAL SAN MATEO COUNTY INVESTIGATION

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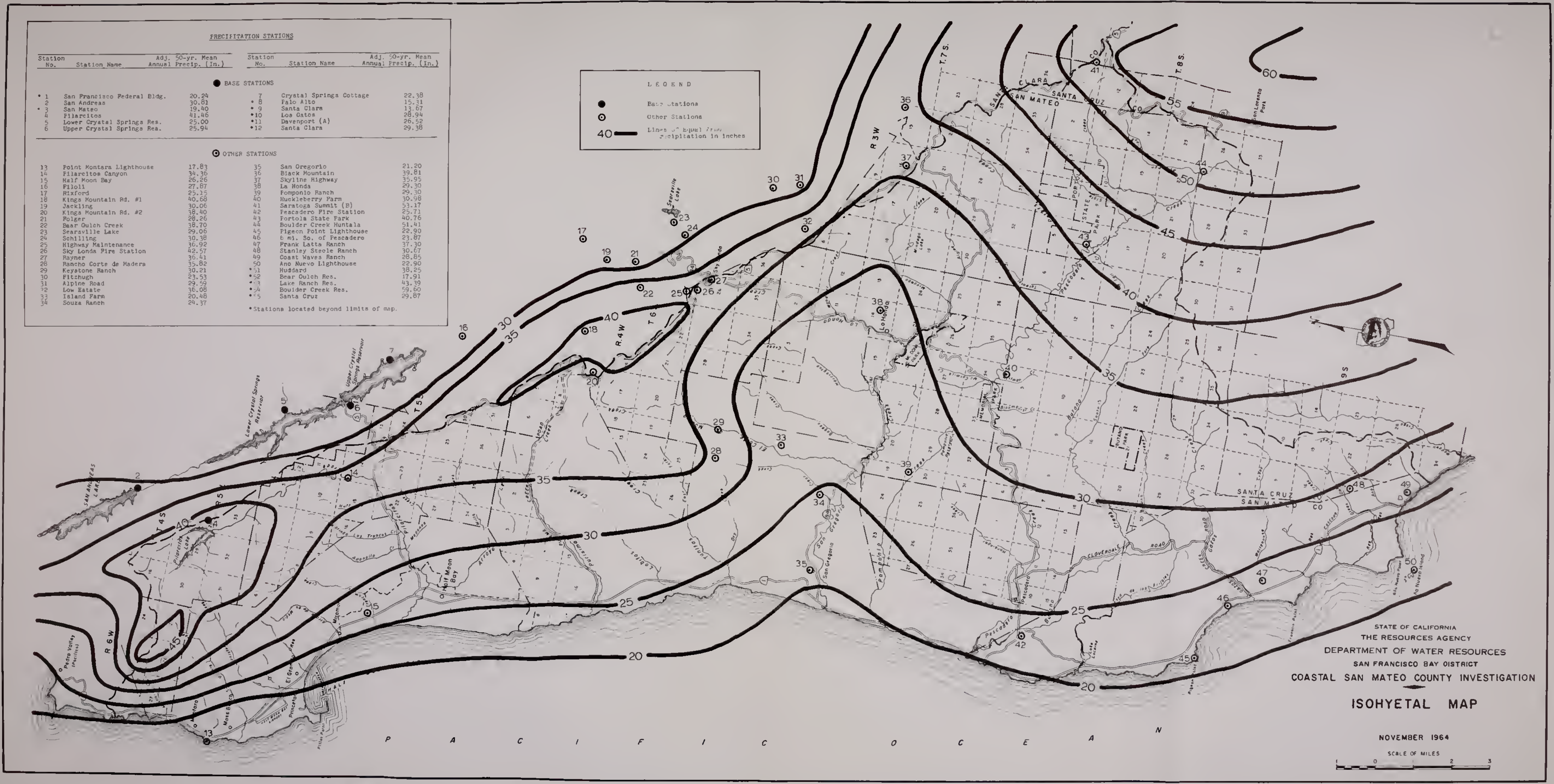
ISOHYETAL MAP

NOVEMBER 1964



PRECIPITATION STATIONS

● BASE STATIONS

Station No.	Station Name	Adj. 50-yr. Mean Annual Precip. (In.)	Station No.	Station Name	Adj. 50-yr. Mean Annual Precip. (In.)
• 1	San Francisco Federal Bldg.	20.24	7	Crystal Springs Cottage	22.38
2	San Andreas	30.81	• 8	Palo Alto	15.31
• 3	San Mateo	19.40	• 9	Santa Clara	13.67
4	Pilarcitos	41.46	•10	Los Gatos	28.94
5	Lower Crystal Springs Res.	25.00	•11	Davenport (A)	26.52
6	Upper Crystal Springs Res.	25.94	•12	Santa Clara	29.38

⊙ OTHER STATIONS

Station No.	Station Name	Adj. 50-yr. Mean Annual Precip. (In.)	Station No.	Station Name	Adj. 50-yr. Mean Annual Precip. (In.)
13	Point Montara Lighthouse	17.83	35	San Gregorio	21.20
14	Pilarcitos Canyon	34.36	36	Black Mountain	39.81
15	Half Moon Bay	26.26	37	Skyline Highway	35.95
16	Filoli	27.87	38	La Honda	29.30
17	Rixford	25.15	39	Pomponio Ranch	29.30
18	Kings Mountain Rd. #1	40.68	40	Huckleberry Farm	30.98
19	Jackling	30.06	41	Saratoga Summit (B)	53.17
20	Kings Mountain Rd. #2	38.40	42	Pescadero Fire Station	25.71
21	Folger	28.26	43	Portola State Park	40.76
22	Bear Gulch Creek	38.70	44	Boulder Creek Huntala	51.41
23	Searsville Lake	29.06	45	Pigeon Point Lighthouse	22.90
24	Schilling	30.38	46	6 mi. So. of Pescadero	23.87
25	Highway Maintenance	36.92	47	Frank Latta Ranch	37.30
26	Sky Londa Fire Station	42.57	48	Stanley Steele Ranch	30.67
27	Rayner	36.41	49	Coast Waves Ranch	28.85
28	Rancho Corte de Madera	35.82	50	Ano Nuevo Lighthouse	22.90
29	Keystone Ranch	30.21	•51	Huddard	38.25
30	Fitzhugh	23.53	•52	Bear Gulch Res.	17.91
31	Alpine Road	29.59	•53	Lake Ranch Res.	43.39
32	Low Estate	36.08	•54	Boulder Creek Res.	59.60
33	Island Farm	20.48	•55	Santa Cruz	29.87
34	Souza Ranch	24.37			

•Stations located beyond limits of map.

LEGEND

- ● Base stations
- ⊙ Other Stations
- 40 ━ Lines of Equal Precipitation in inches

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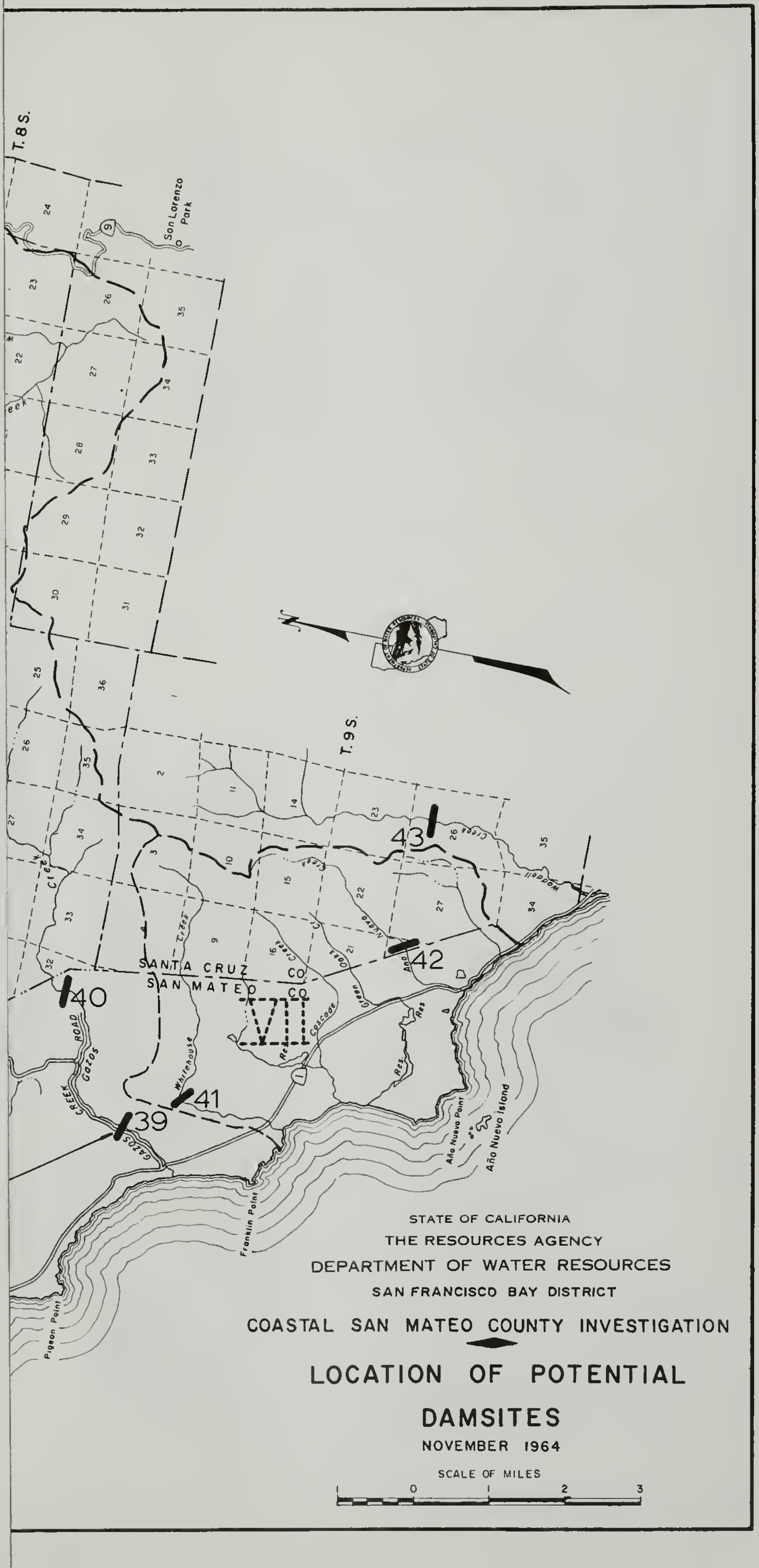
COASTAL SAN MATEO COUNTY INVESTIGATION

ISOHYETAL MAP

NOVEMBER 1964

PLATE 4



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SAN FRANCISCO BAY DISTRICT

COASTAL SAN MATEO COUNTY INVESTIGATION

◆

LOCATION OF POTENTIAL DAMSITES

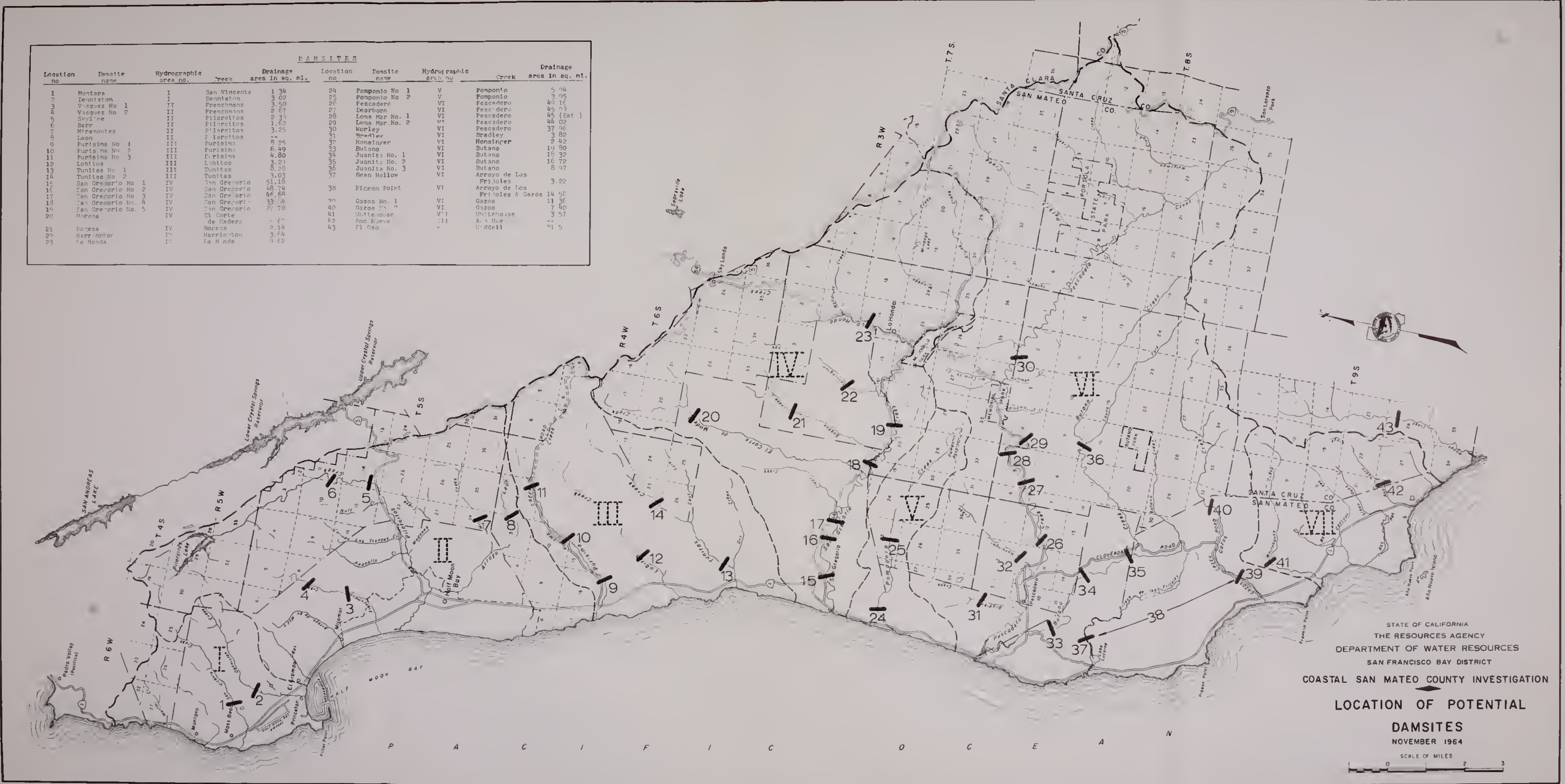
NOVEMBER 1964

SCALE OF MILES
1 0 1 2 3

PLATE 4

DAMSITES

Location no	Damsite name	Hydrographic area no.	Creek	Drainage area in sq. mi.
1	Montara	I	San Vincente	1.34
2	Denniston	I	Denniston	3.02
3	Vasquez No 1	II	Frenchmans	3.50
4	Vasquez No 2	II	Frenchmans	2.67
5	Skyline	II	Pilarcitos	2.33
6	Barr	II	Pilarcitos	1.62
7	Miramontes	II	Pilarcitos	3.25
8	Leon	II	Pilarcitos	--
9	Purisima No 1	III	Purisima	8.25
10	Purisima No 2	III	Purisima	6.49
11	Purisima No 3	III	Purisima	4.80
12	Lobitos	III	Lobitos	3.27
13	Tunitas No 1	III	Tunitas	8.28
14	Tunitas No 2	III	Tunitas	3.03
15	San Gregorio No 1	IV	San Gregorio	51.18
16	San Gregorio No 2	IV	San Gregorio	48.74
17	San Gregorio No 3	IV	San Gregorio	46.68
18	San Gregorio No. 4	IV	San Gregorio	33.[illegible]
19	San Gregorio No. 5	IV	San Gregorio	27.70
20	Morena	IV	El Corte de Madera	[illegible]
21	Boresa	IV	Boresa	2.14
22	Harrington	IV	Harrington	3.64
23	La Honda	IV	La Honda	9.62
24	Pomponio No 1	V	Pomponio	5.94
25	Pomponio No 2	V	Pomponio	3.95
26	Pescadero	VI	Pescadero	49.16
27	Dearborn	VI	Pescadero	45.93
28	Loma Mar No. 1	VI	Pescadero	45 (Est.)
29	Loma Mar No. 2	VI	Pescadero	44.02
30	Worley	VI	Pescadero	37.96
31	Bradley	VI	Bradley	3.82
32	Honsinger	VI	Honsinger	2.42
33	Butano	VI	Butano	19.80
34	Juanita No. 1	VI	Butano	18.32
35	Juanita No. 2	VI	Butano	16.72
36	Juanita No. 3	VI	Butano	8.97
37	Bean Hollow	VI	Arroyo de Los Frijoles	3.22
38	Pigeon Point	VI	Arroyo de Los Frijoles & Gazos	14.58
39	Gazos No. 1	VI	Gazos	11.36
40	Gazos No. 2	VI	Gazos	7.40
41	Whitehouse	VII	Whitehouse	3.57
42	Ano Nuevo	VII	Ano Nuevo	--
43	El Oso	-	Waddell	21.5



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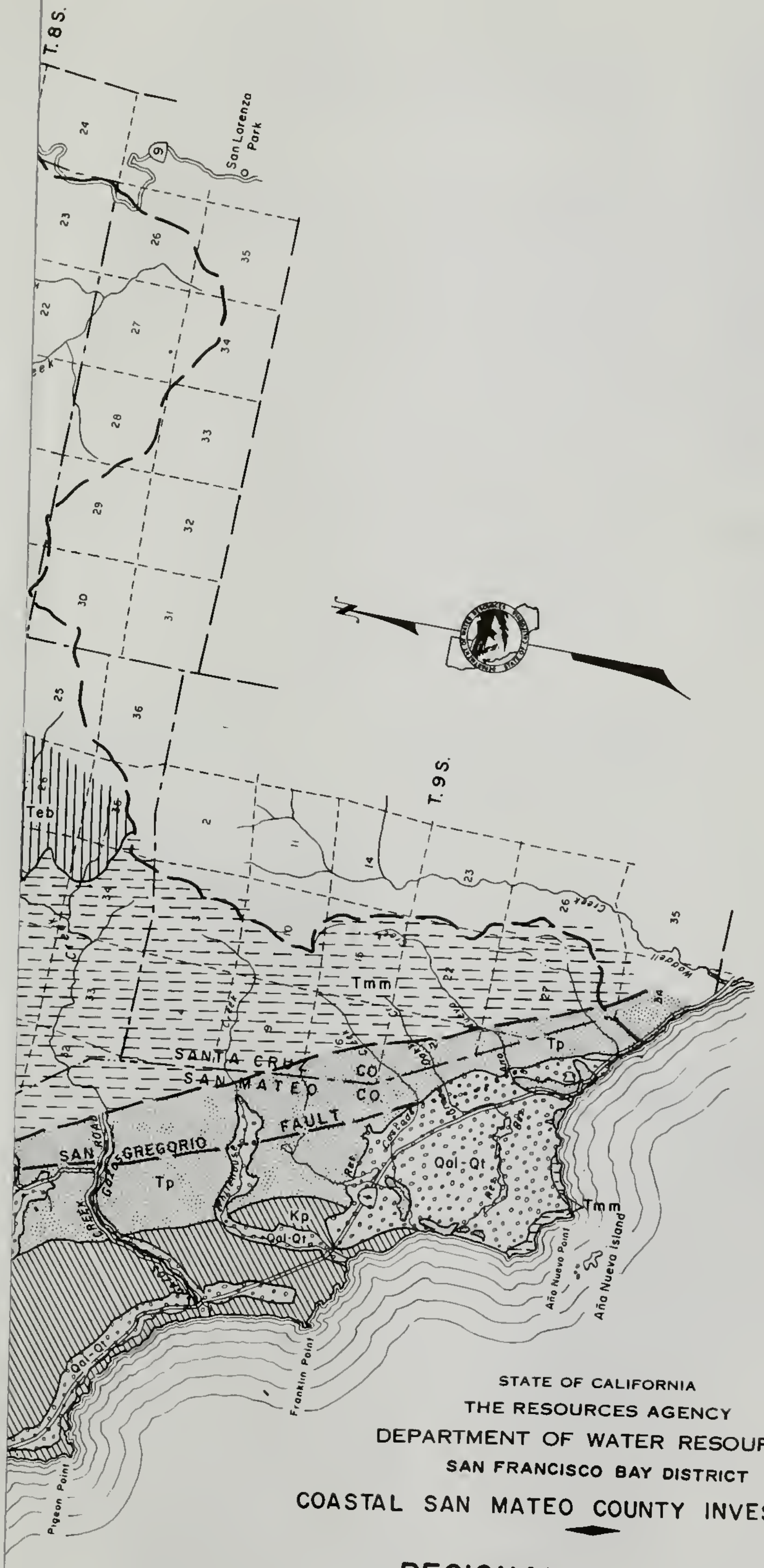
COASTAL SAN MATEO COUNTY INVESTIGATION

LOCATION OF POTENTIAL DAMSITES

NOVEMBER 1964

PLATE 5



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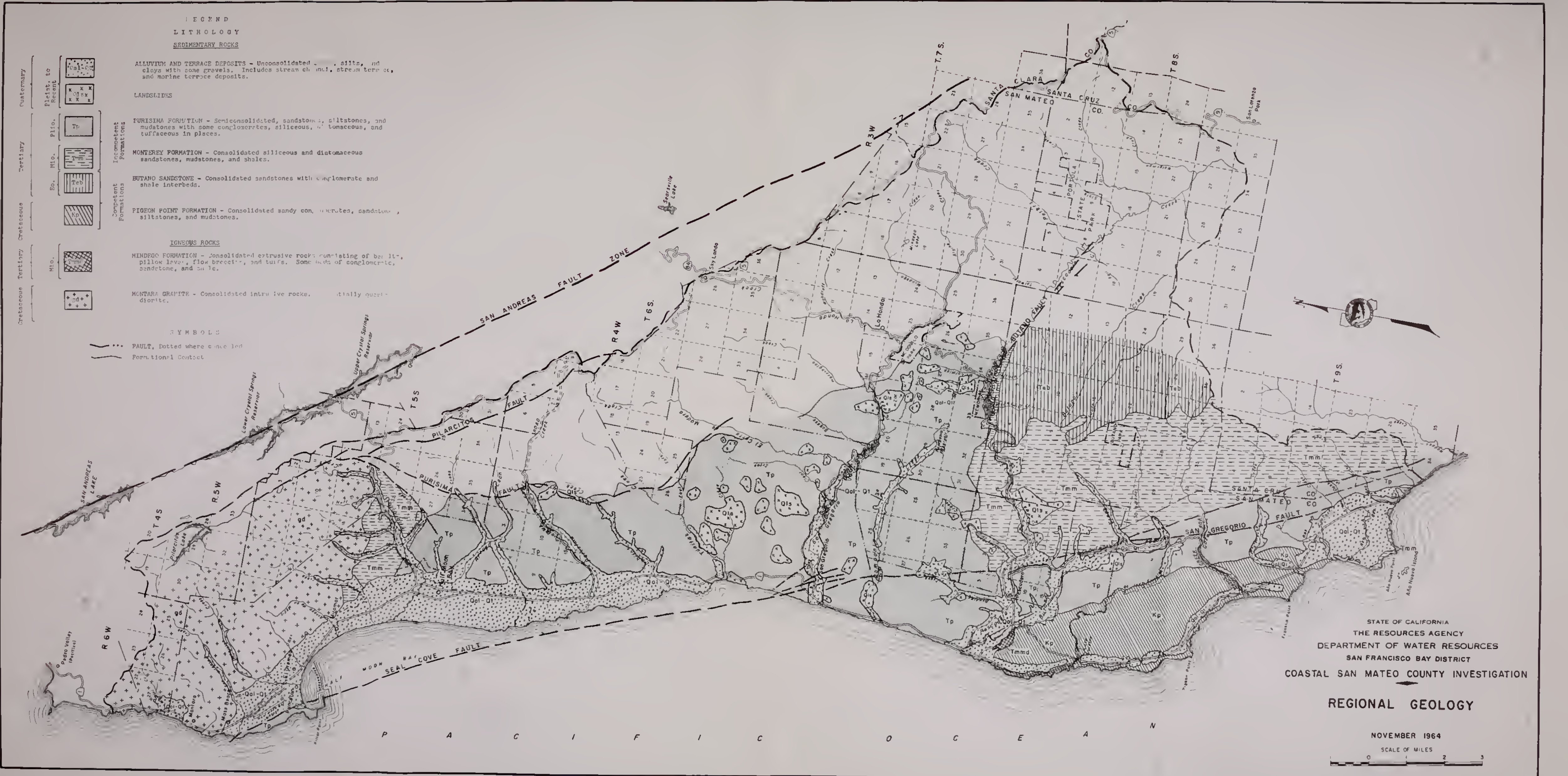
SAN FRANCISCO BAY DISTRICT

COASTAL SAN MATEO COUNTY INVESTIGATION

REGIONAL GEOLOGY

NOVEMBER 1964

SCALE OF MILES
0 1 2 3



LEGEND

LITHOLOGY

SEDIMENTARY ROCKS

Quaternary	Pleist. to Recent	Qal-Ql	ALLUVIUM AND TERRACE DEPOSITS - Unconsolidated sands, silts, and clays with some gravels. Includes stream channel, stream terrace, and marine terrace deposits.
		Qls	LANDSLIDES
Tertiary	Plio.	Tp	PURISIMA FORMATION - Semiconsolidated, sandstones, siltstones, and mudstones with some conglomerates, siliceous, diatomaceous, and tuffaceous in places. (Incompetent Formations)
	Mio.	Tmm	MONTEREY FORMATION - Consolidated siliceous and diatomaceous sandstones, mudstones, and shales. (Incompetent Formations)
	Eo.	Teb	BUTANO SANDSTONE - Consolidated sandstones with conglomerate and shale interbeds. (Competent Formations)
Cretaceous		Kp	PIGEON POINT FORMATION - Consolidated sandy conglomerates, sandstones, siltstones, and mudstones. (Competent Formations)

IGNEOUS ROCKS

Tertiary	Mio.	Tmmd	MINDEGO FORMATION - Consolidated extrusive rocks consisting of basalts, pillow lavas, flow breccias, and tuffs. Some beds of conglomerate, sandstone, and shale.
Cretaceous		gd	MONTARA GRANITE - Consolidated intrusive rocks. Essentially quartz-diorite.

SYMBOLS

FAULT, Dotted where concealed

Formational Contact

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SAN FRANCISCO BAY DISTRICT

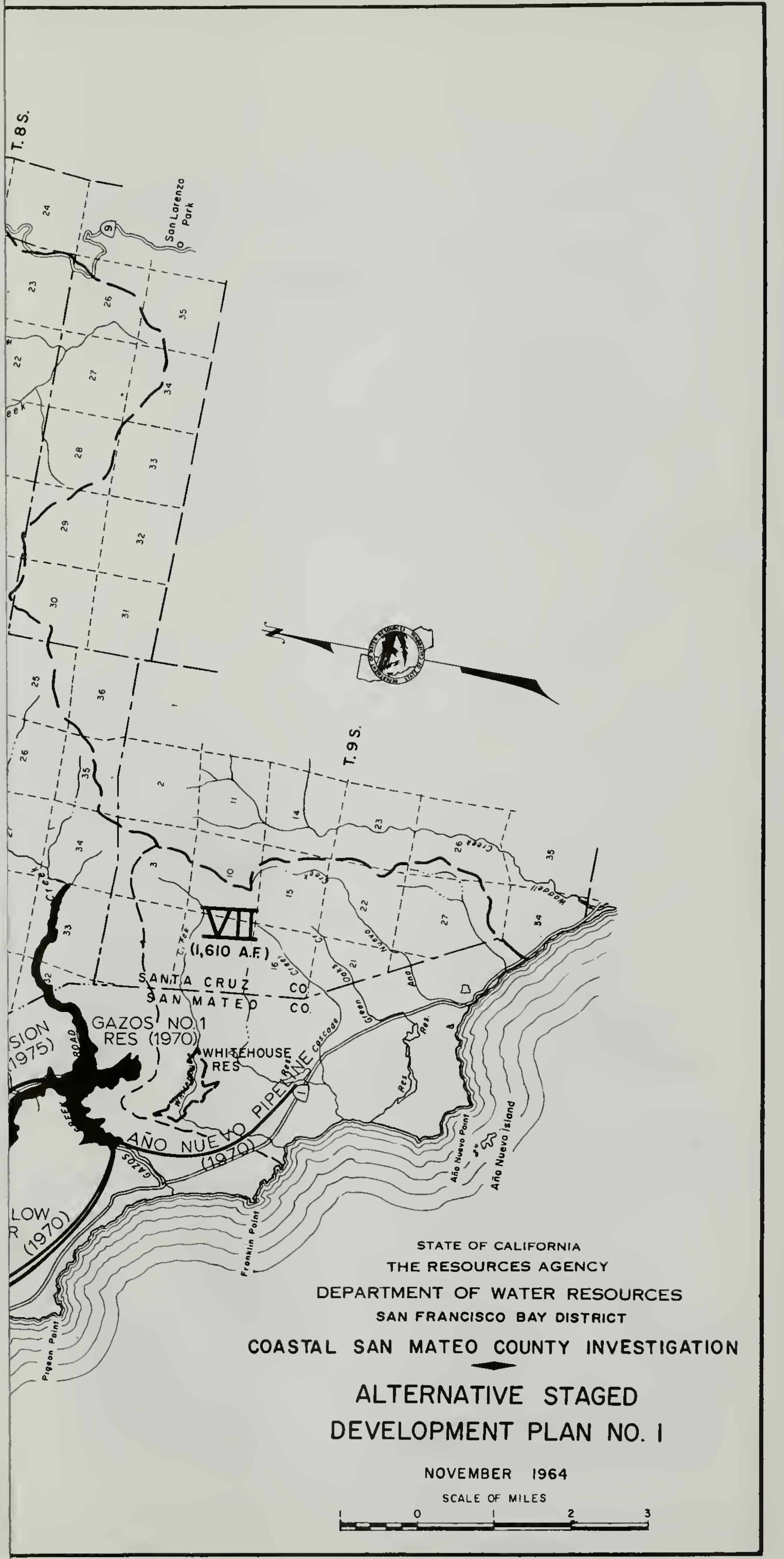
COASTAL SAN MATEO COUNTY INVESTIGATION

REGIONAL GEOLOGY

NOVEMBER 1964

SCALE OF MILES
0 1 2 3

PLATE 6



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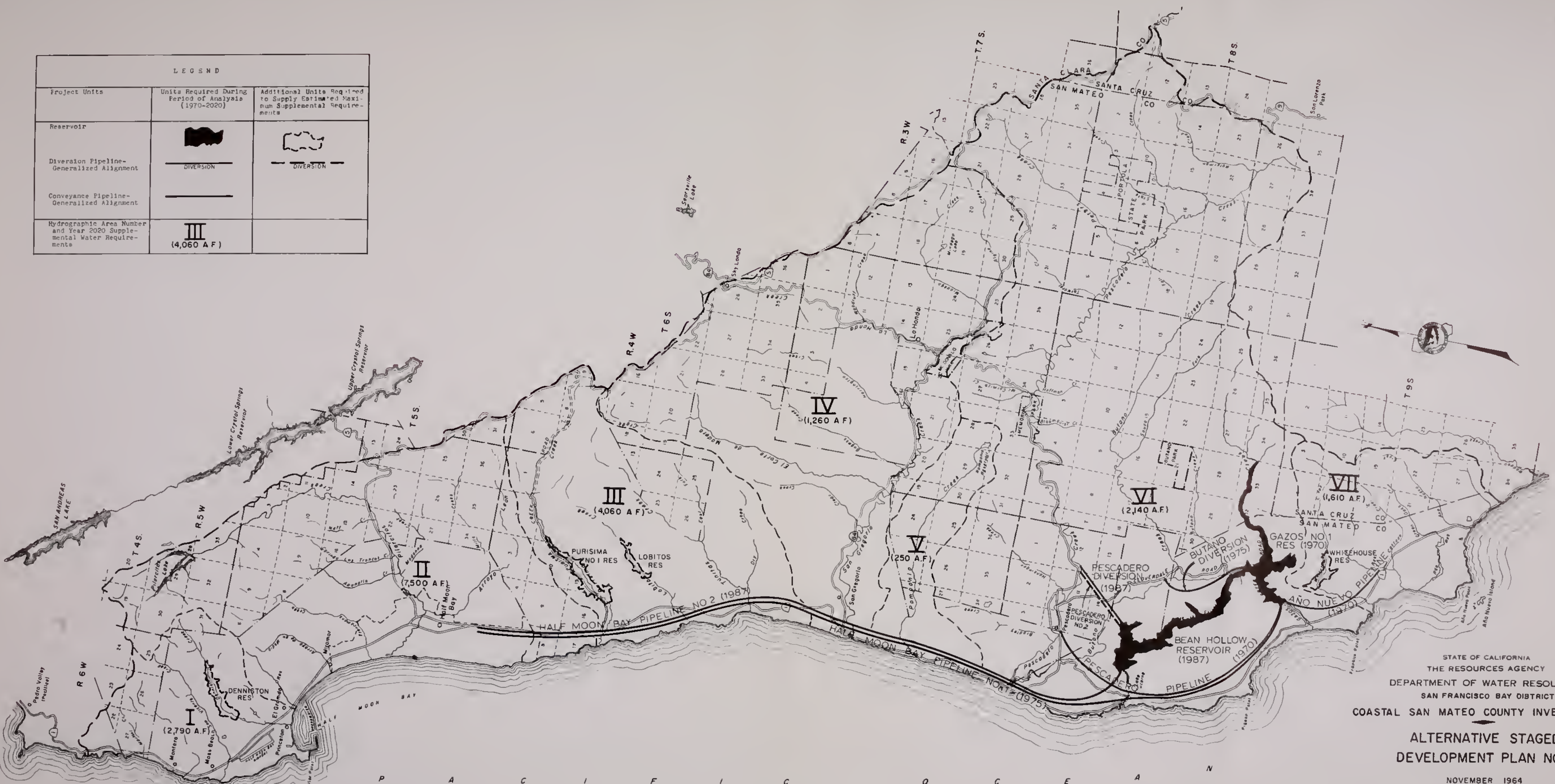
COASTAL SAN MATEO COUNTY INVESTIGATION

ALTERNATIVE STAGED
DEVELOPMENT PLAN NO. I

NOVEMBER 1964



LEGEND		
Project Units	Units Required During Period of Analysis (1970-2020)	Additional Units Required to Supply Estimated Maximum Supplemental Requirements
Reservoir	■	⬚
Diversion Pipeline-Generalized Alignment	—— DIVERSION	– – – DIVERSION
Conveyance Pipeline-Generalized Alignment	——	
Hydrographic Area Number and Year 2020 Supplemental Water Requirements	III (4,060 A F)	

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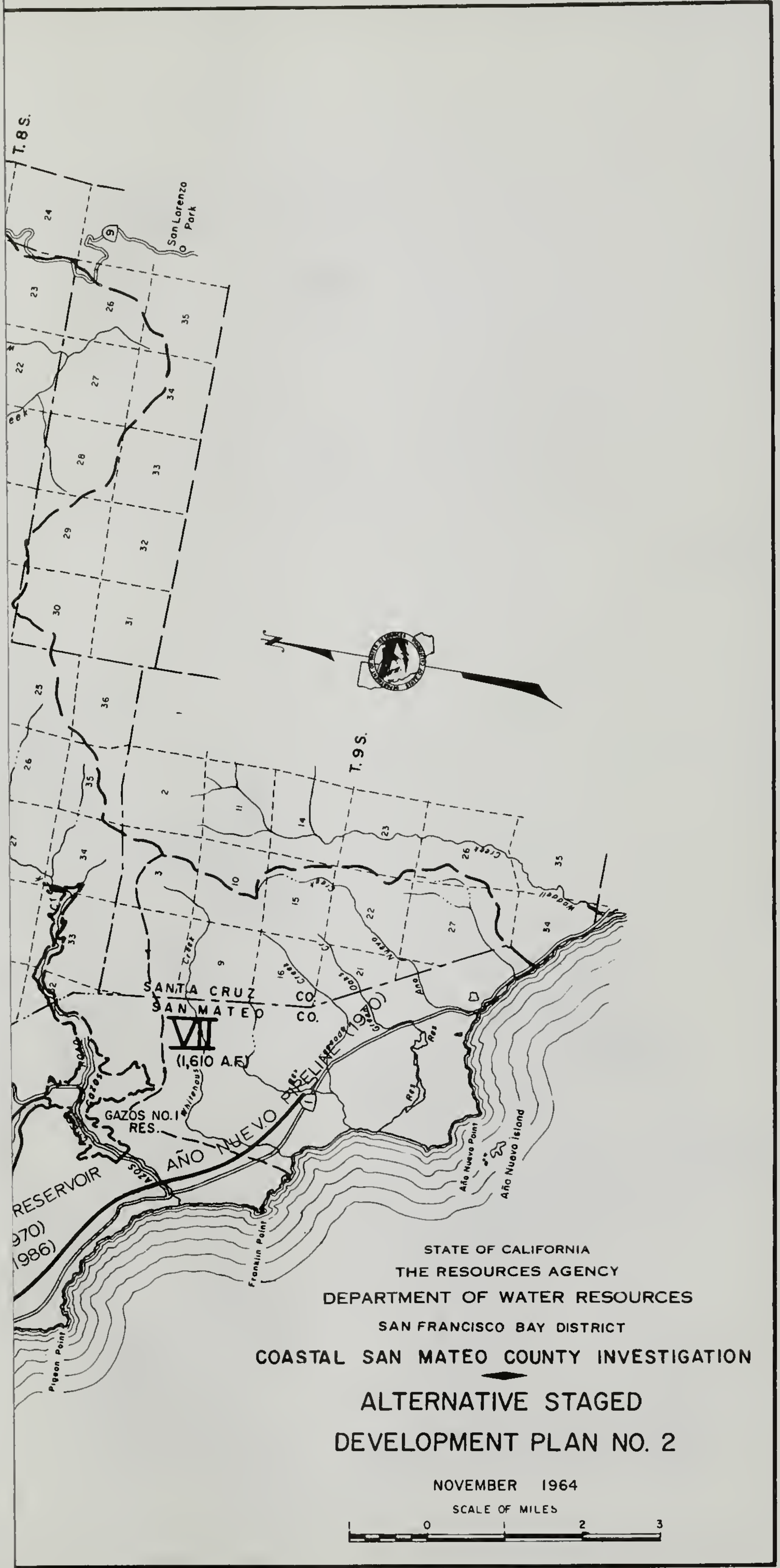
COASTAL SAN MATEO COUNTY INVESTIGATION

ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 1

NOVEMBER 1964

SCALE OF MILES
1 0 1 2 3



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SAN FRANCISCO BAY DISTRICT

COASTAL SAN MATEO COUNTY INVESTIGATION

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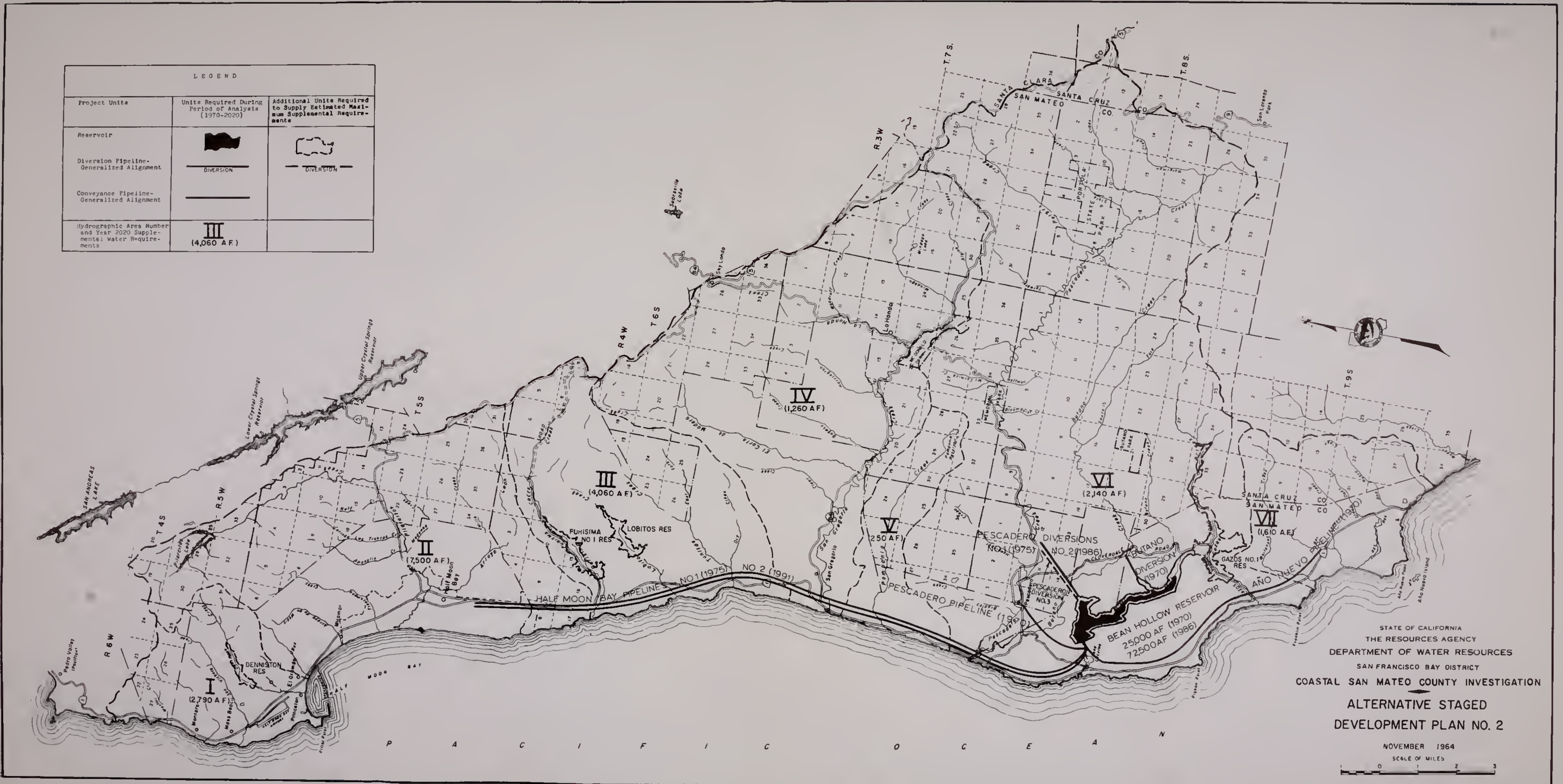
ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 2

NOVEMBER 1964

SCALE OF MILES
1 0 1 2 3



LEGEND

Project Units	Units Required During Period of Analysis (1970-2020)	Additional Units Required to Supply Estimated Maximum Supplemental Requirements
Reservoir	▬	⬚
Diversion Pipeline-Generalized Alignment	——— DIVERSION	— — — DIVERSION
Conveyance Pipeline-Generalized Alignment	———	
Hydrographic Area Number and Year 2020 Supplemental Water Requirements	III (4,060 A.F.)	

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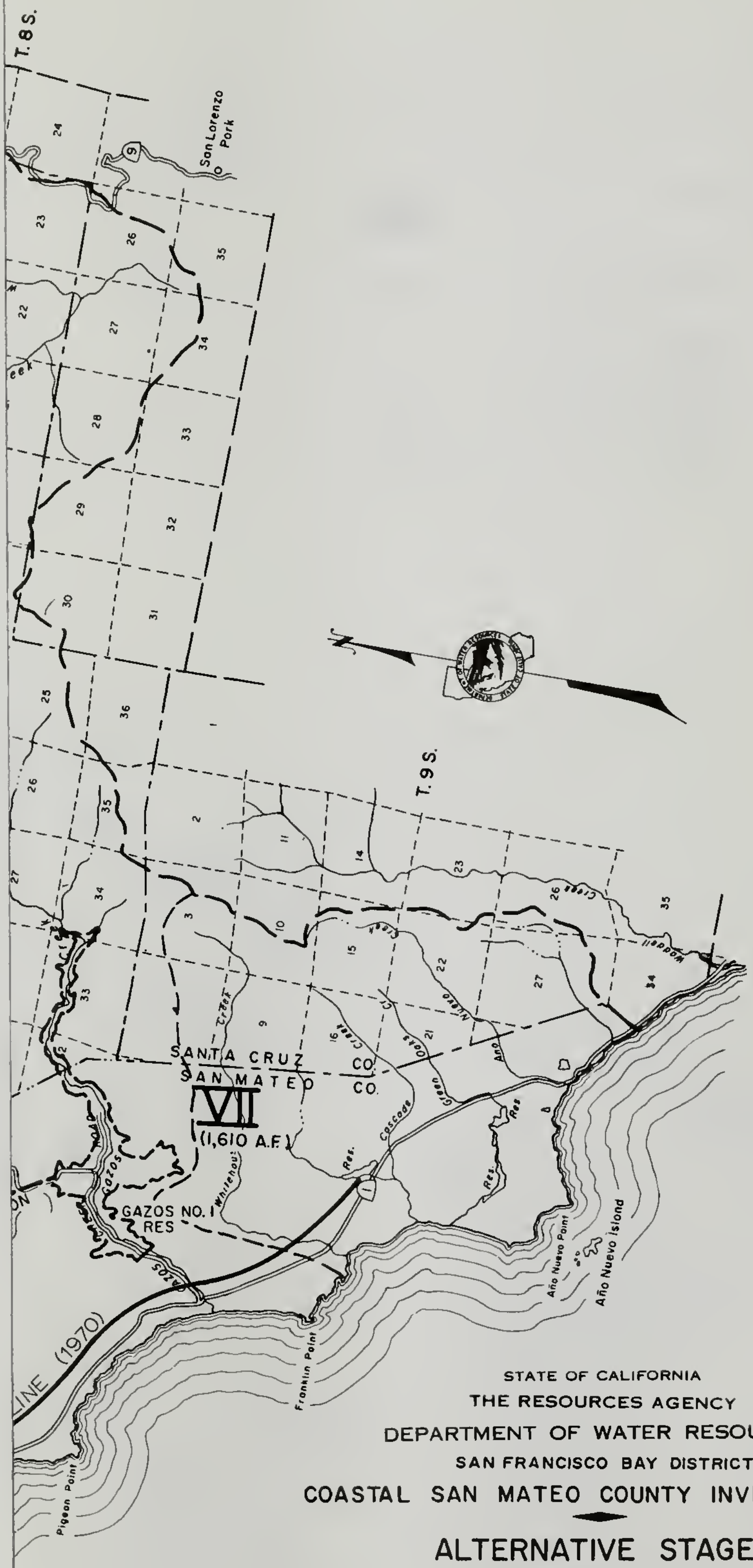
COASTAL SAN MATEO COUNTY INVESTIGATION

ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 2

NOVEMBER 1964

SCALE OF MILES
1 0 1 2 3



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SAN FRANCISCO BAY DISTRICT
COASTAL SAN MATEO COUNTY INVESTIGATION

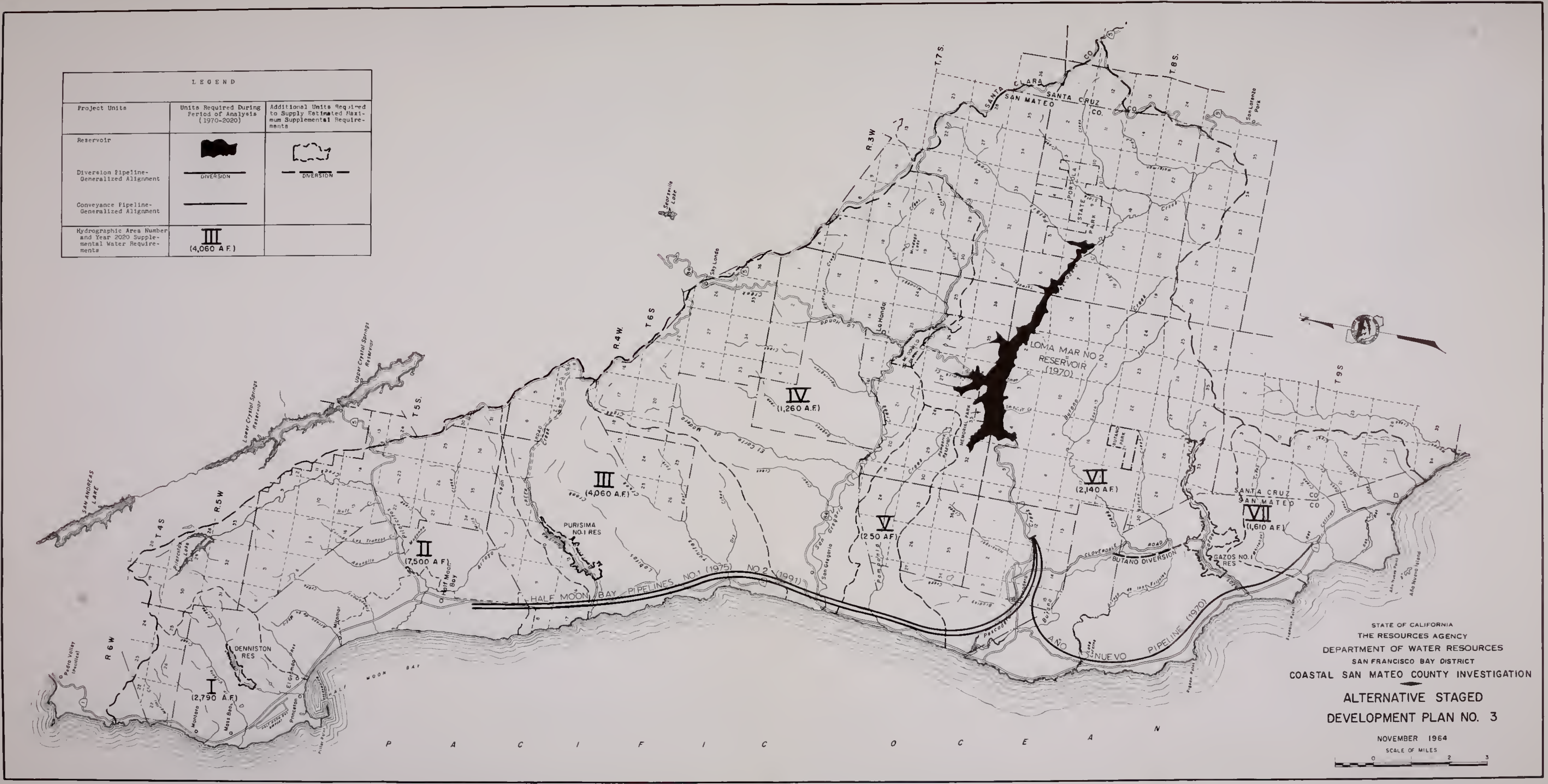
◆

ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 3

NOVEMBER 1964

SCALE OF MILES
0 1 2 3

PLATE B



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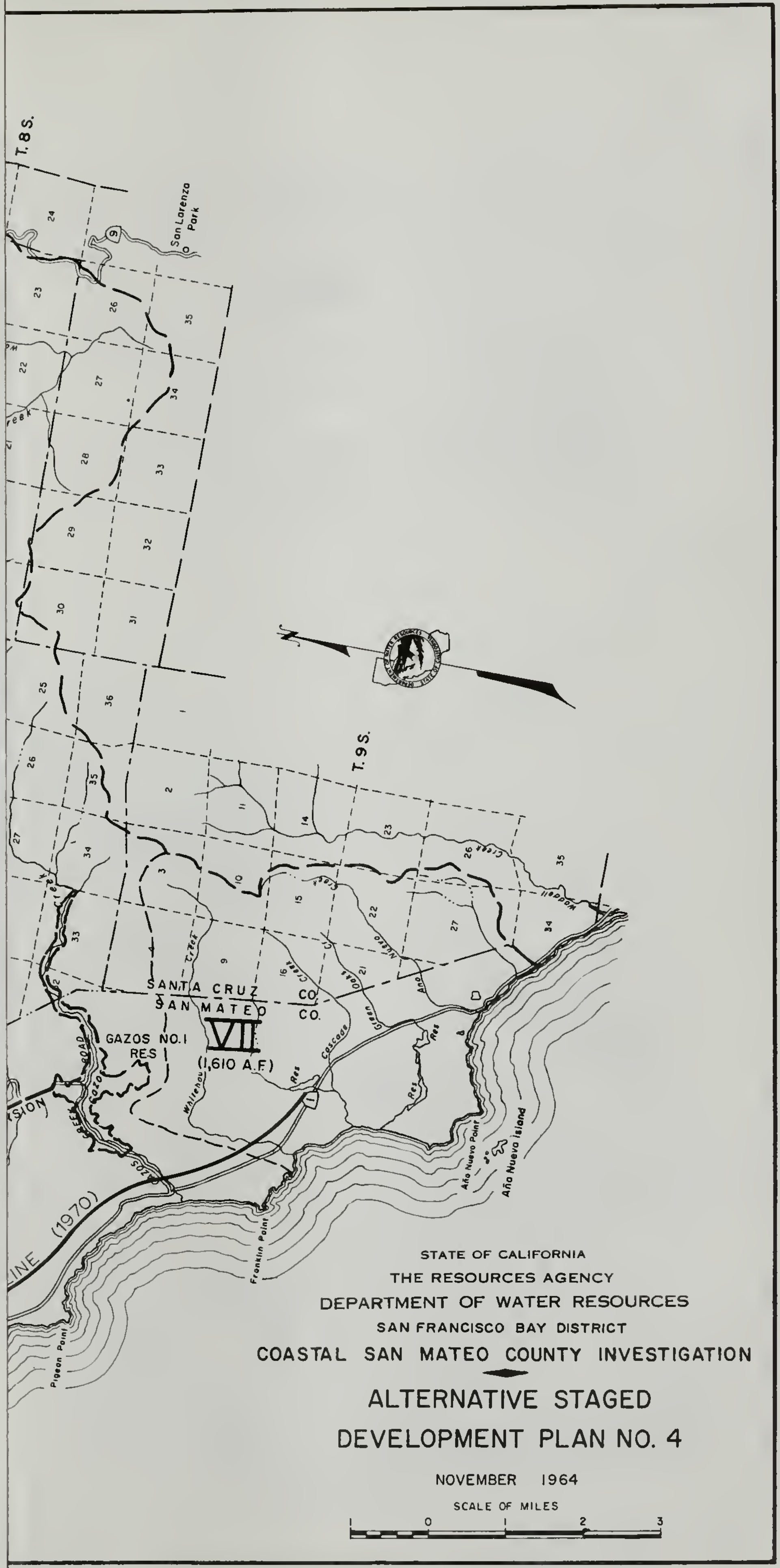
SAN FRANCISCO BAY DISTRICT
COASTAL SAN MATEO COUNTY INVESTIGATION

ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 3

NOVEMBER 1964

SCALE OF MILES
0 2 3

PLATE 9



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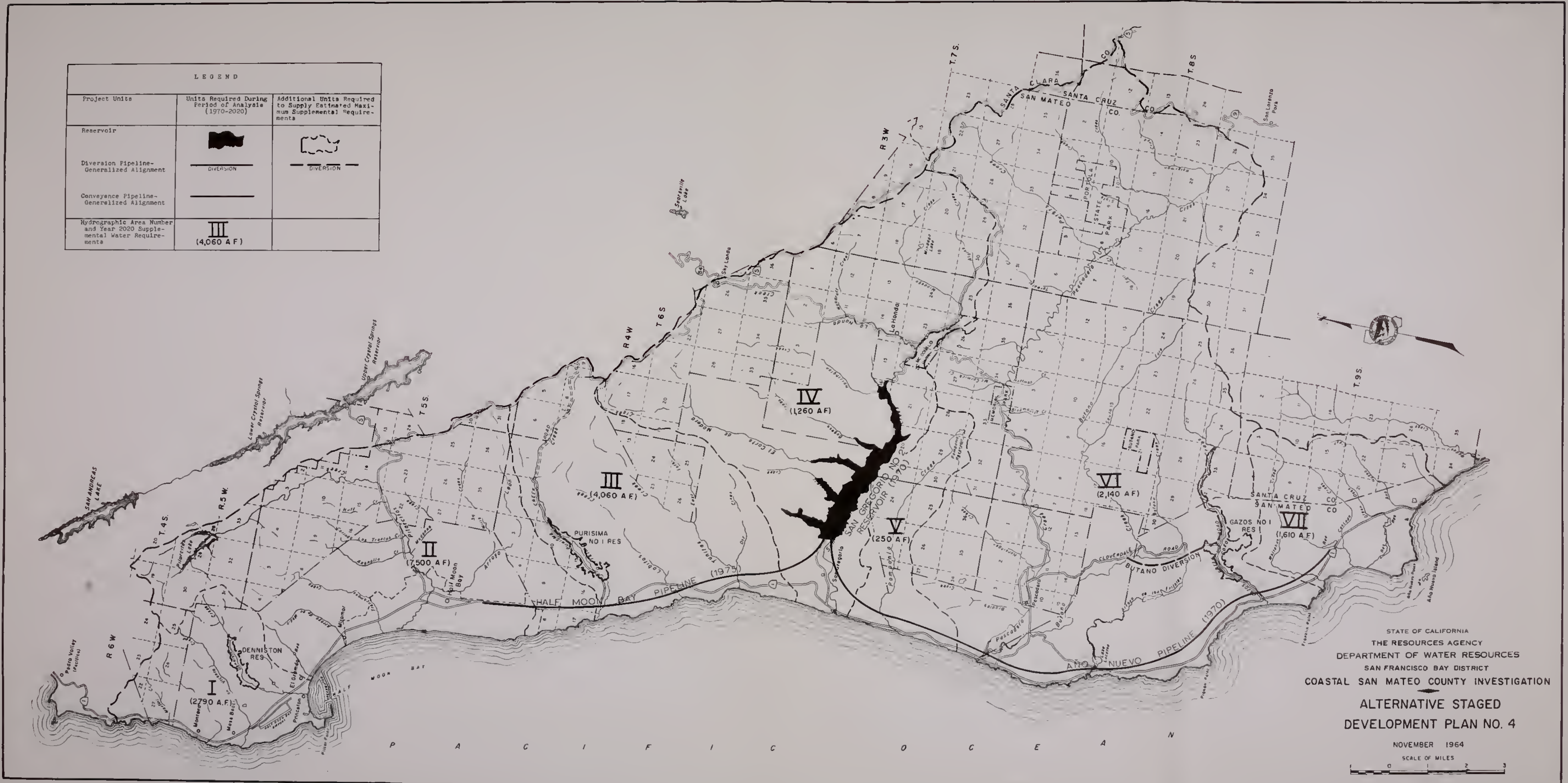
COASTAL SAN MATEO COUNTY INVESTIGATION

ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 4

NOVEMBER 1964

SCALE OF MILES

1 0 1 2 3



LEGEND		
Project Units	Units Required During Period of Analysis (1970-2020)	Additional Units Required to Supply Estimated Maximum Supplemental Requirements
Reservoir	■	⬚
Diversion Pipeline-Generalized Alignment	DIVERSION	DIVERSION
Conveyence Pipeline-Generalized Alignment	—	
Hydrographic Area Number and Year 2020 Supplemental Water Requirements	III (4,060 A F)	

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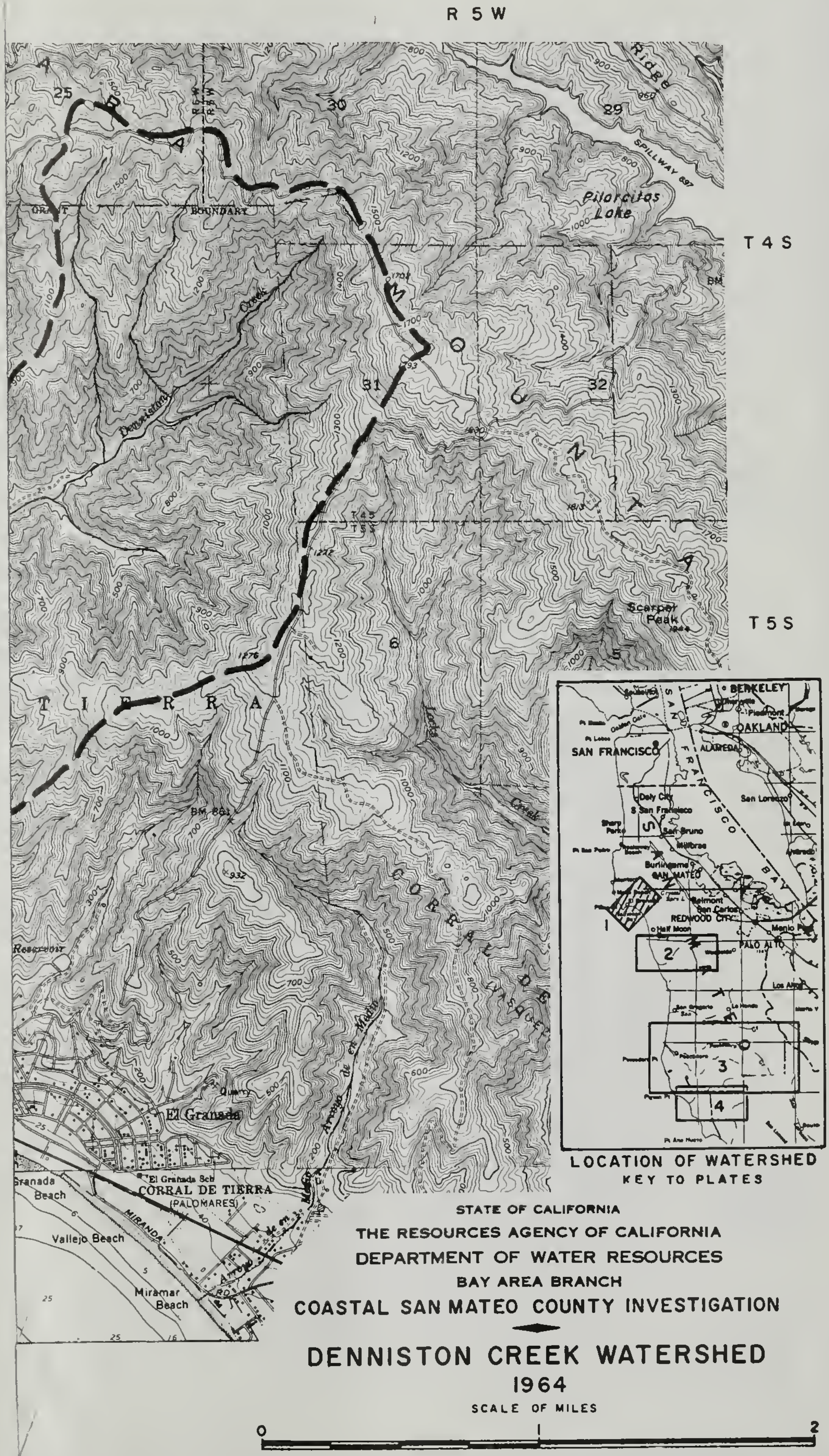
SAN FRANCISCO BAY DISTRICT
COASTAL SAN MATEO COUNTY INVESTIGATION

◆

ALTERNATIVE STAGED DEVELOPMENT PLAN NO. 4

NOVEMBER 1964



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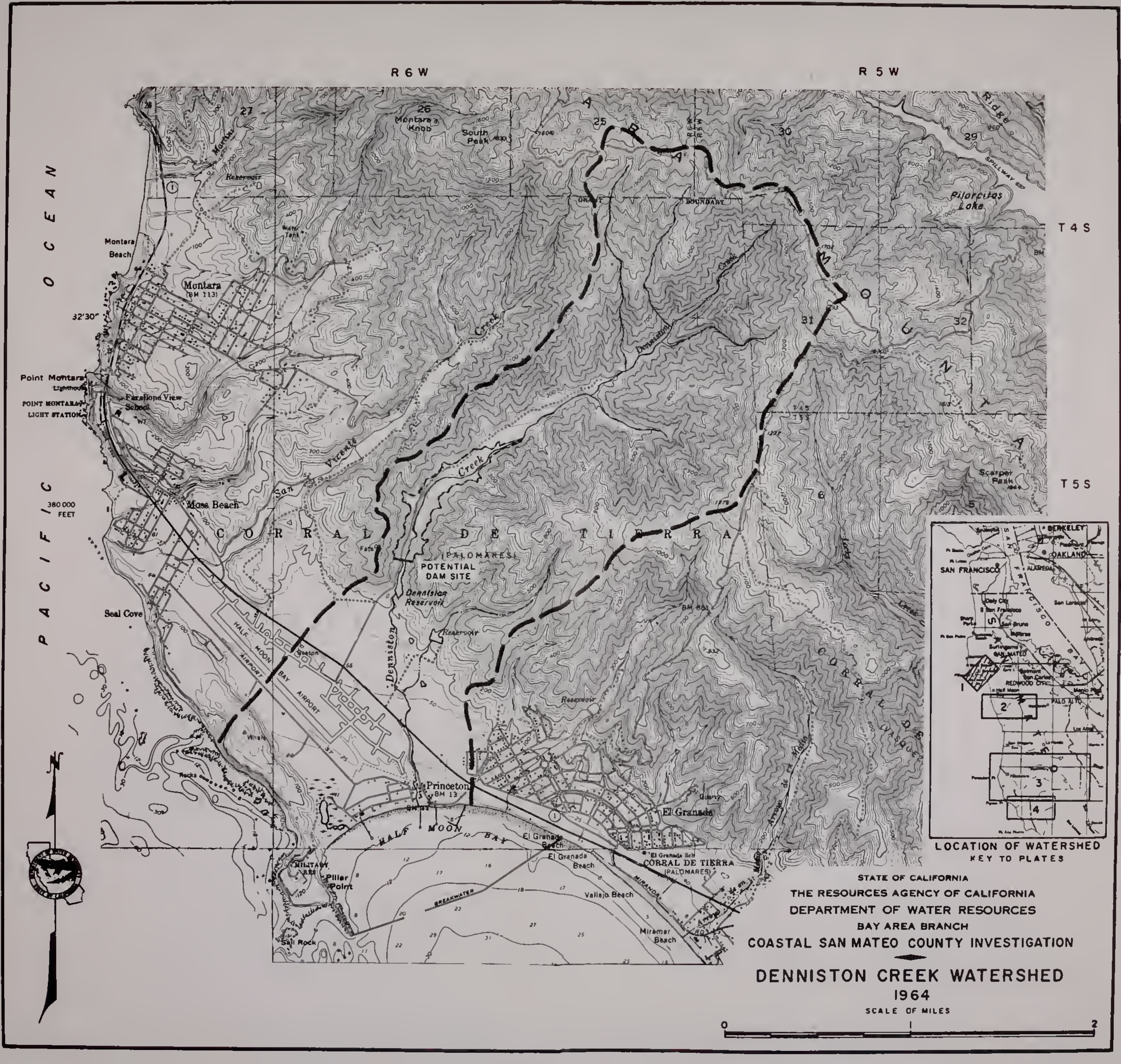
DENNISTON CREEK WATERSHED

1964



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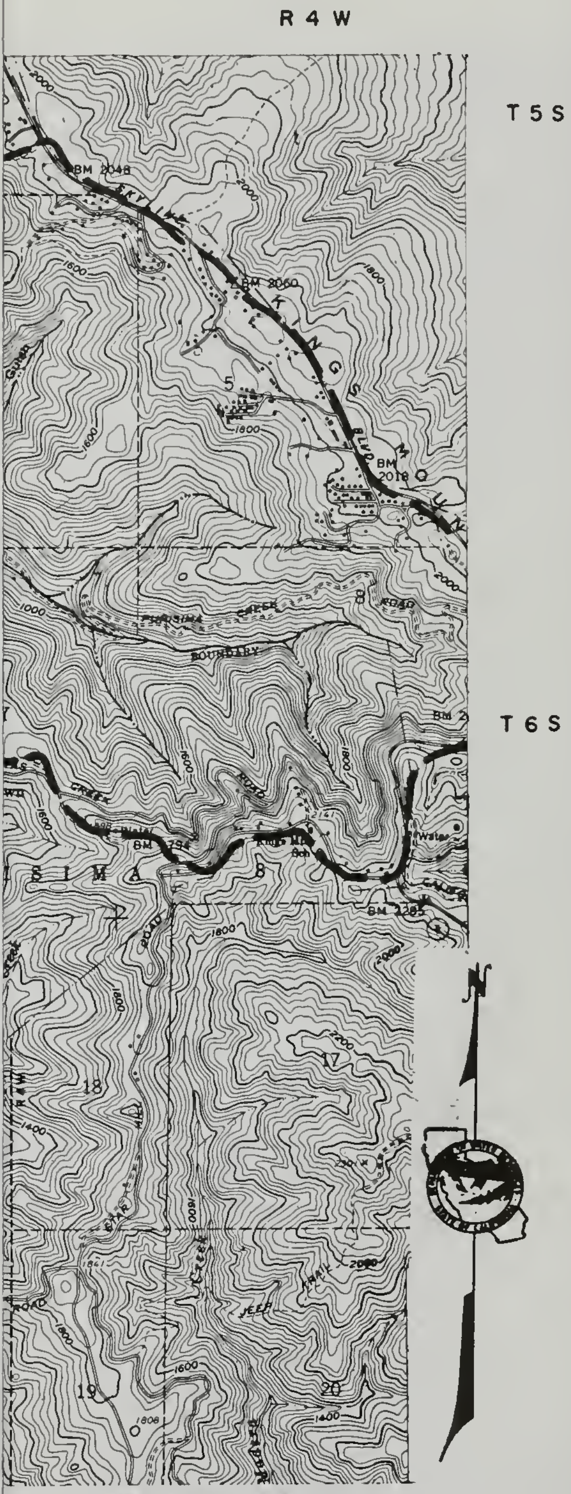
DENNISTON CREEK WATERSHED
1964

SCALE OF MILES
0 1 2



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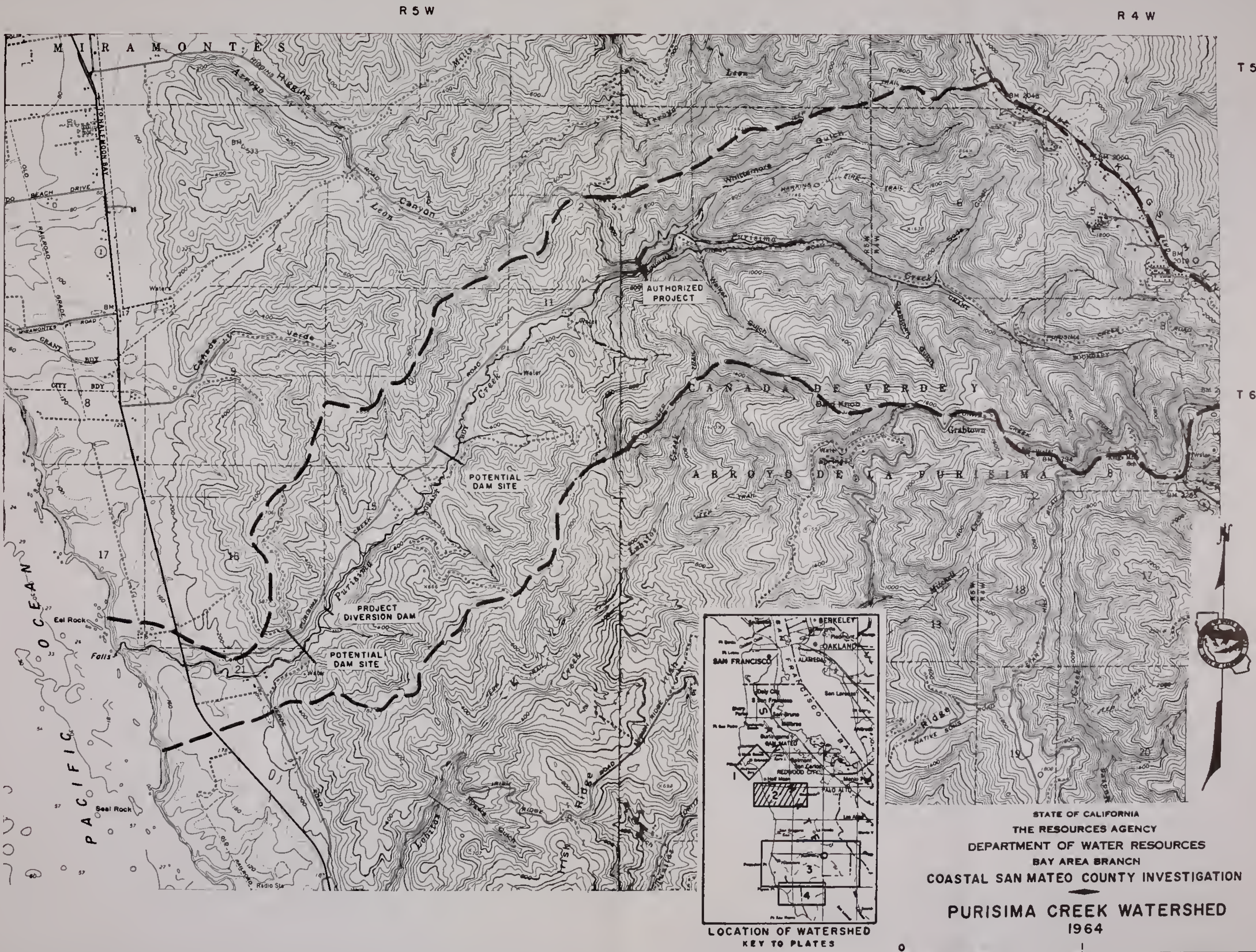
RISIMA CREEK WATERSHED
1964



LOCATION OF WATERSHED
KEY TO PLATES

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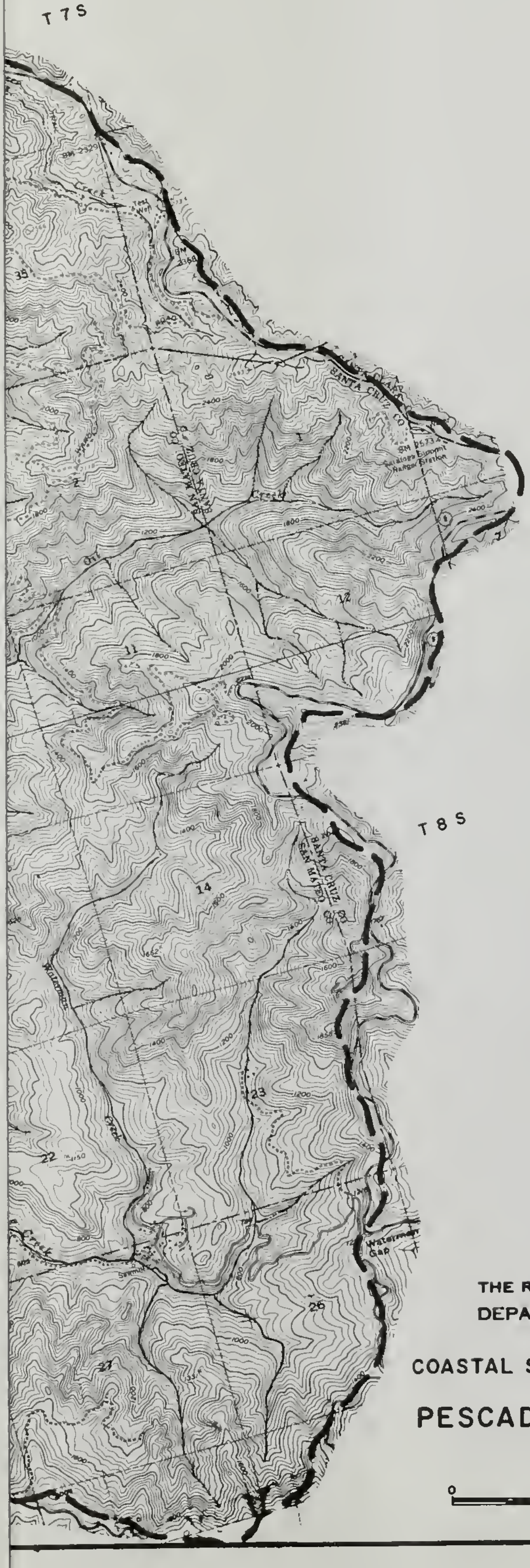
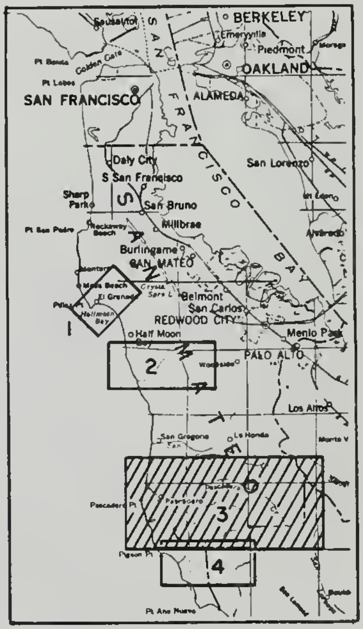
PURISIMA CREEK WATERSHED
1964





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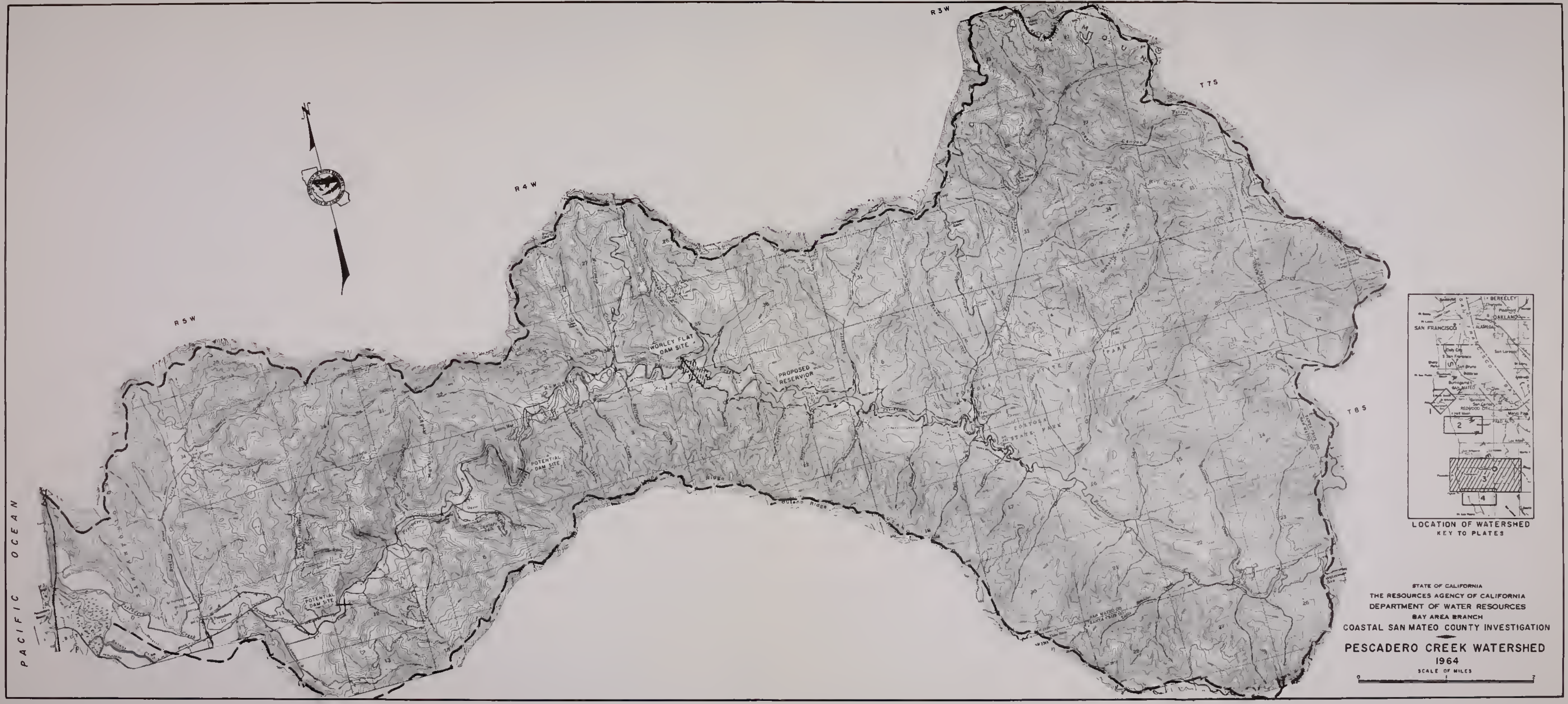
PESCADERO CREEK WATERSHED

1964

SCALE OF MILES

0 1 2



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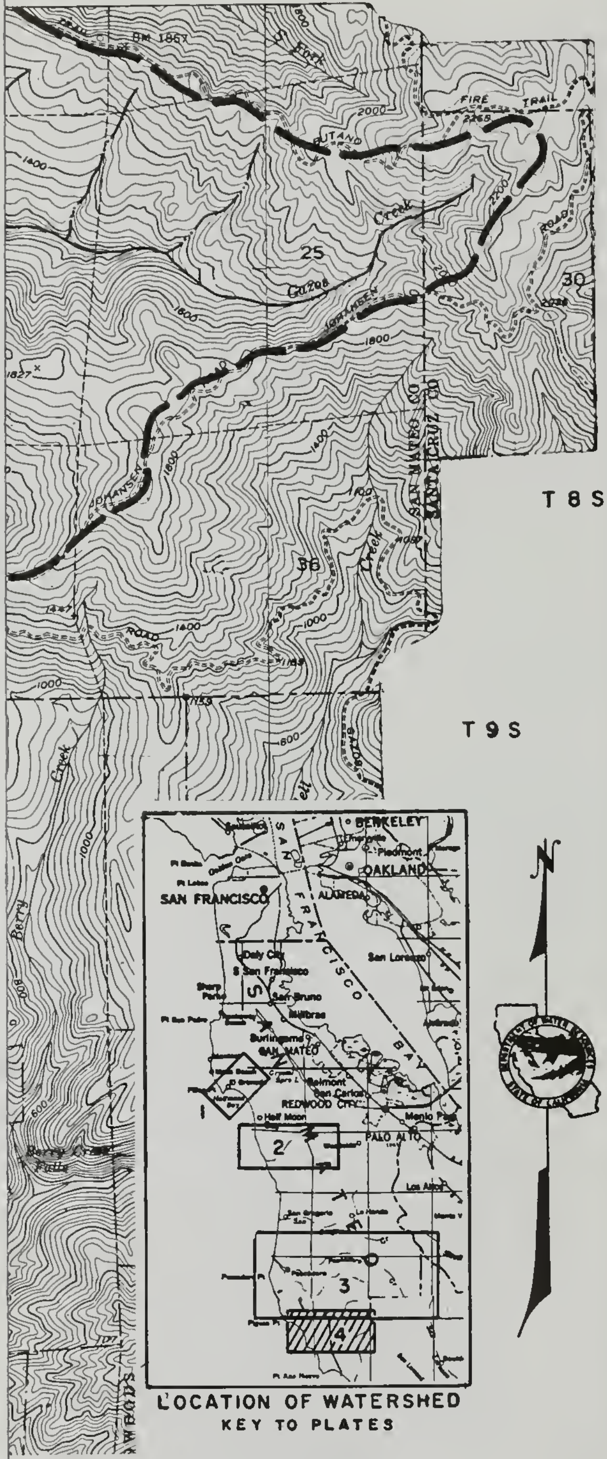
PESCADERO CREEK WATERSHED
1964

SCALE OF MILES
0 1 2

Plate C4



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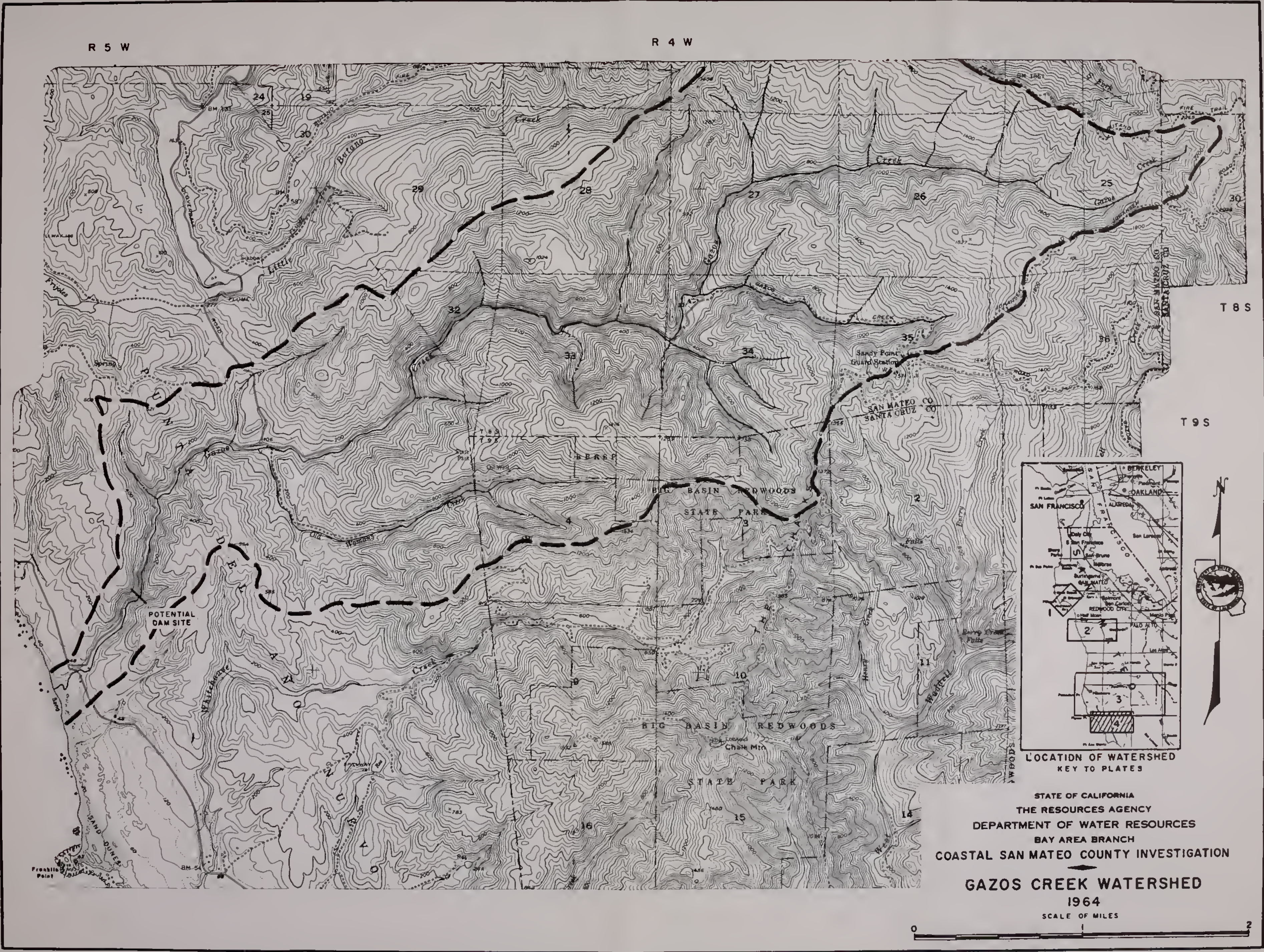
GAZOS CREEK WATERSHED

1964

SCALE OF MILES

1 2



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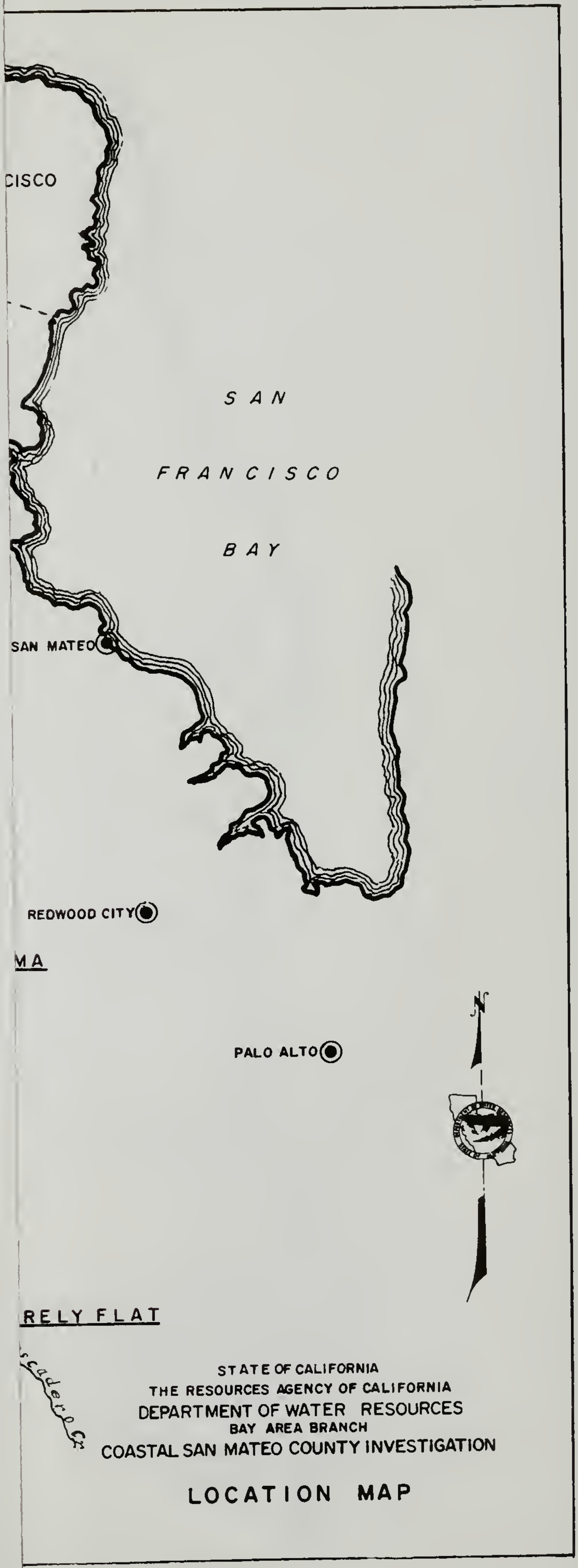
GAZOS CREEK WATERSHED

1964

SCALE OF MILES



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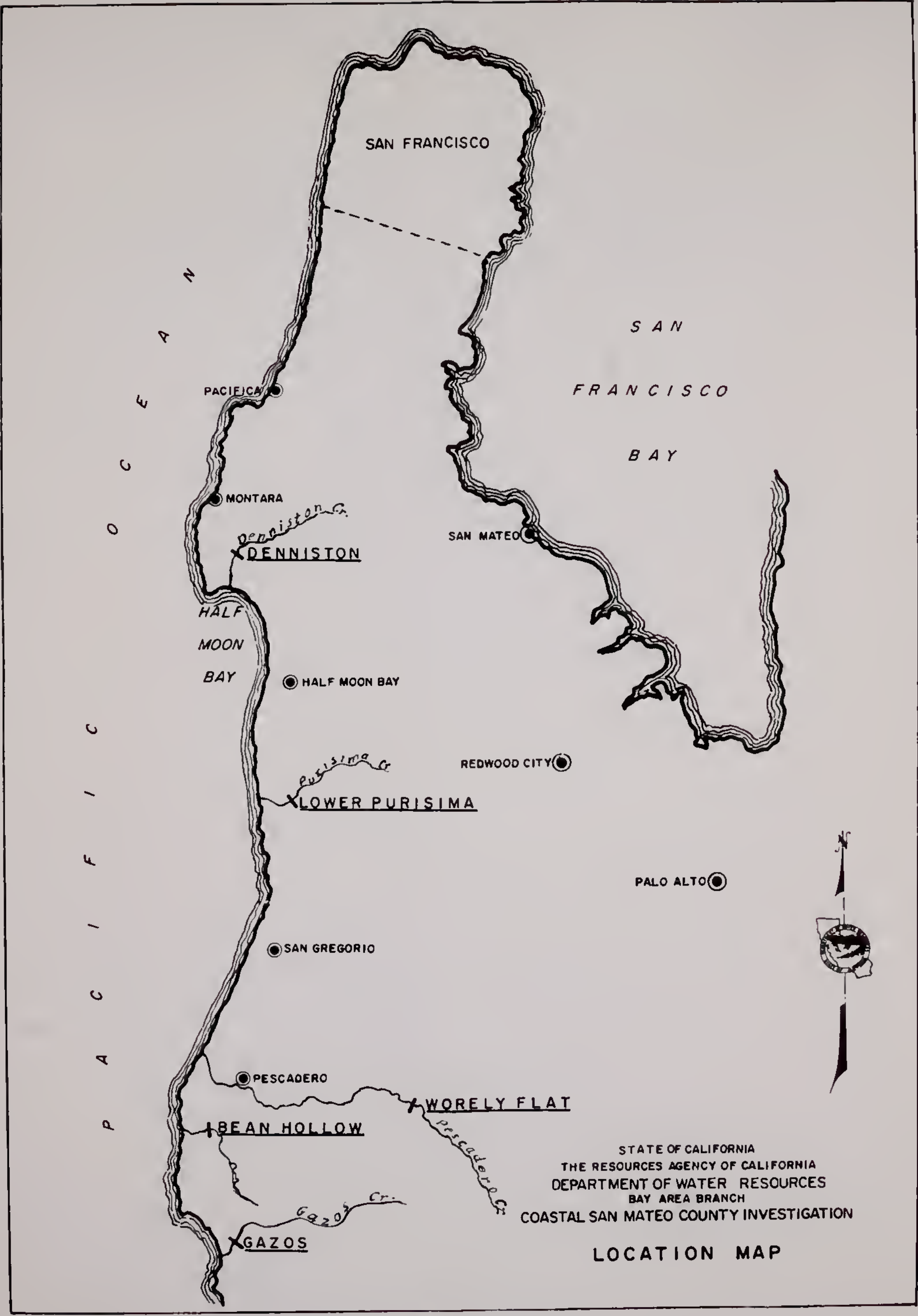
LOCATION MAP



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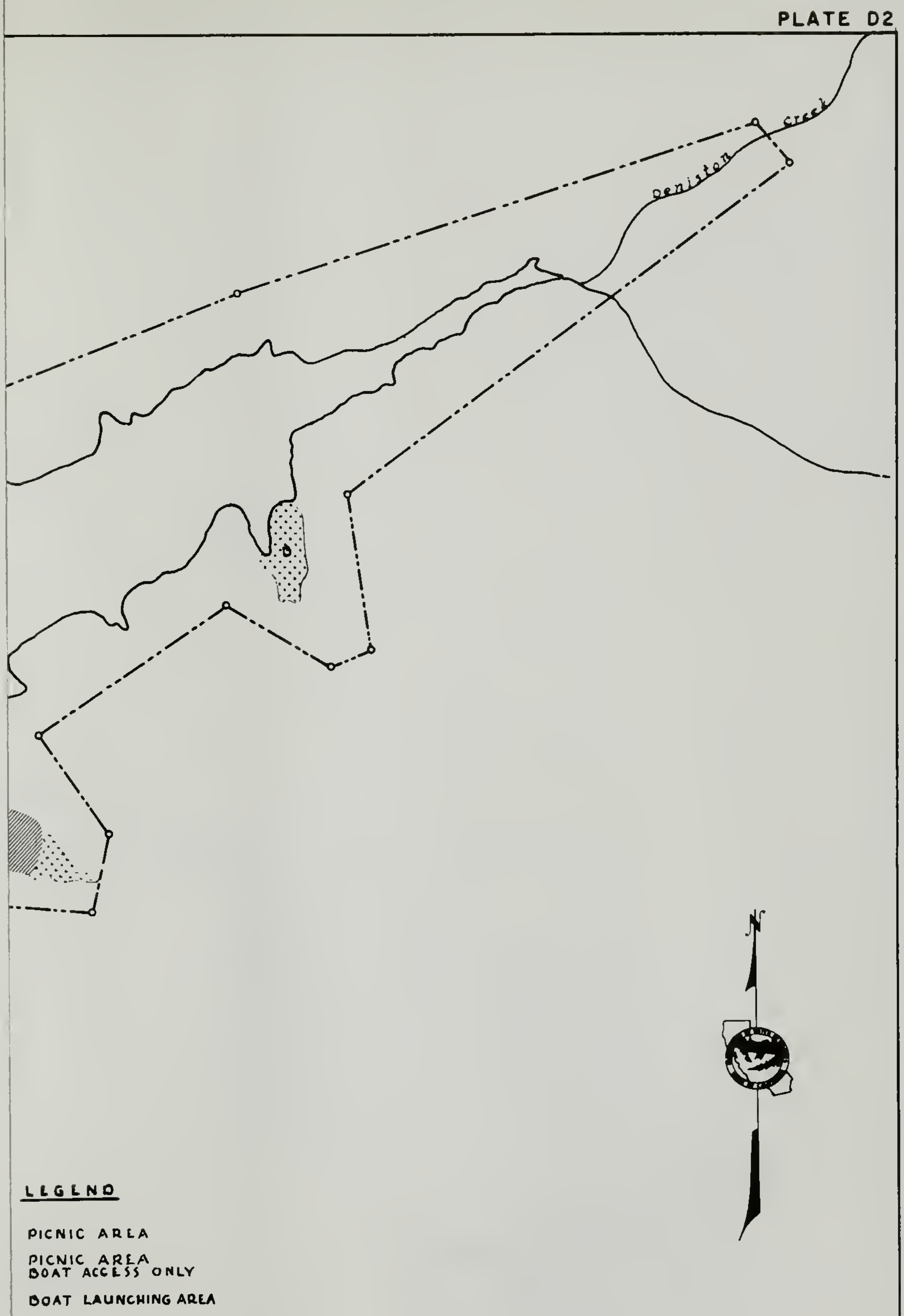
LOCATION MAP

PLATE D2



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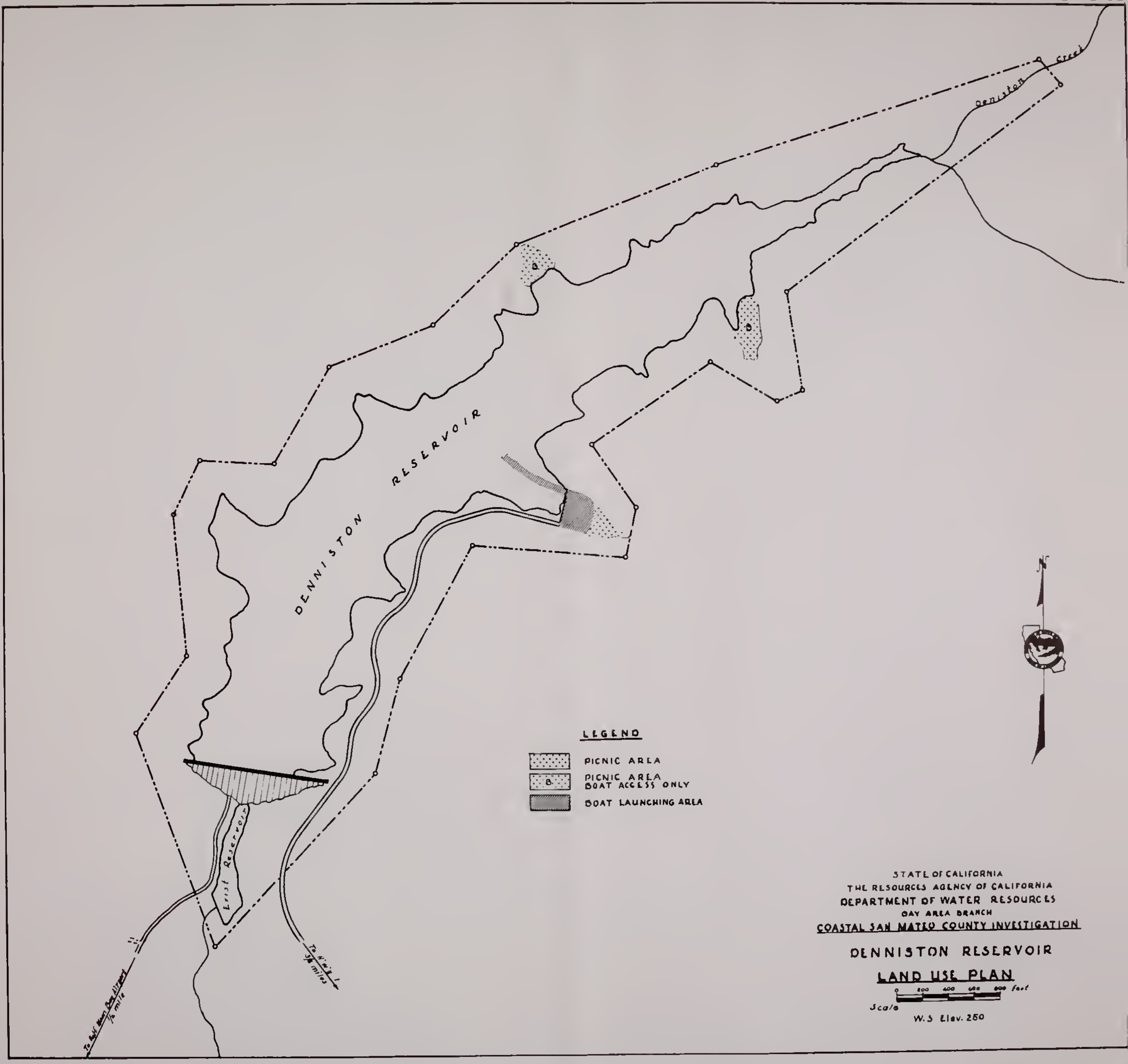
DENNISTON RESERVOIR

LAND USE PLAN

0 200 400 600 800 feet
Scale

W.S. Elev. 250



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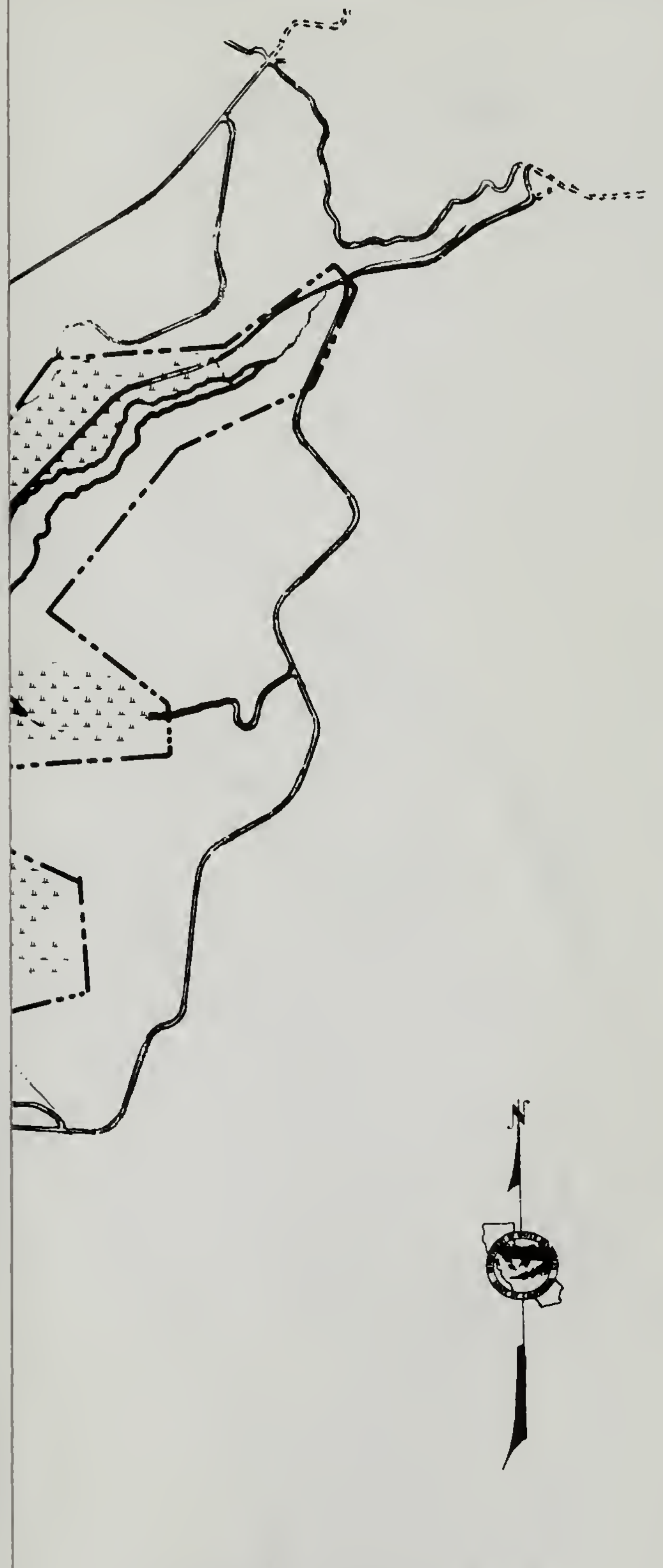
DENNISTON RESERVOIR

LAND USE PLAN



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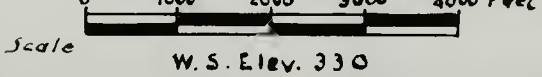
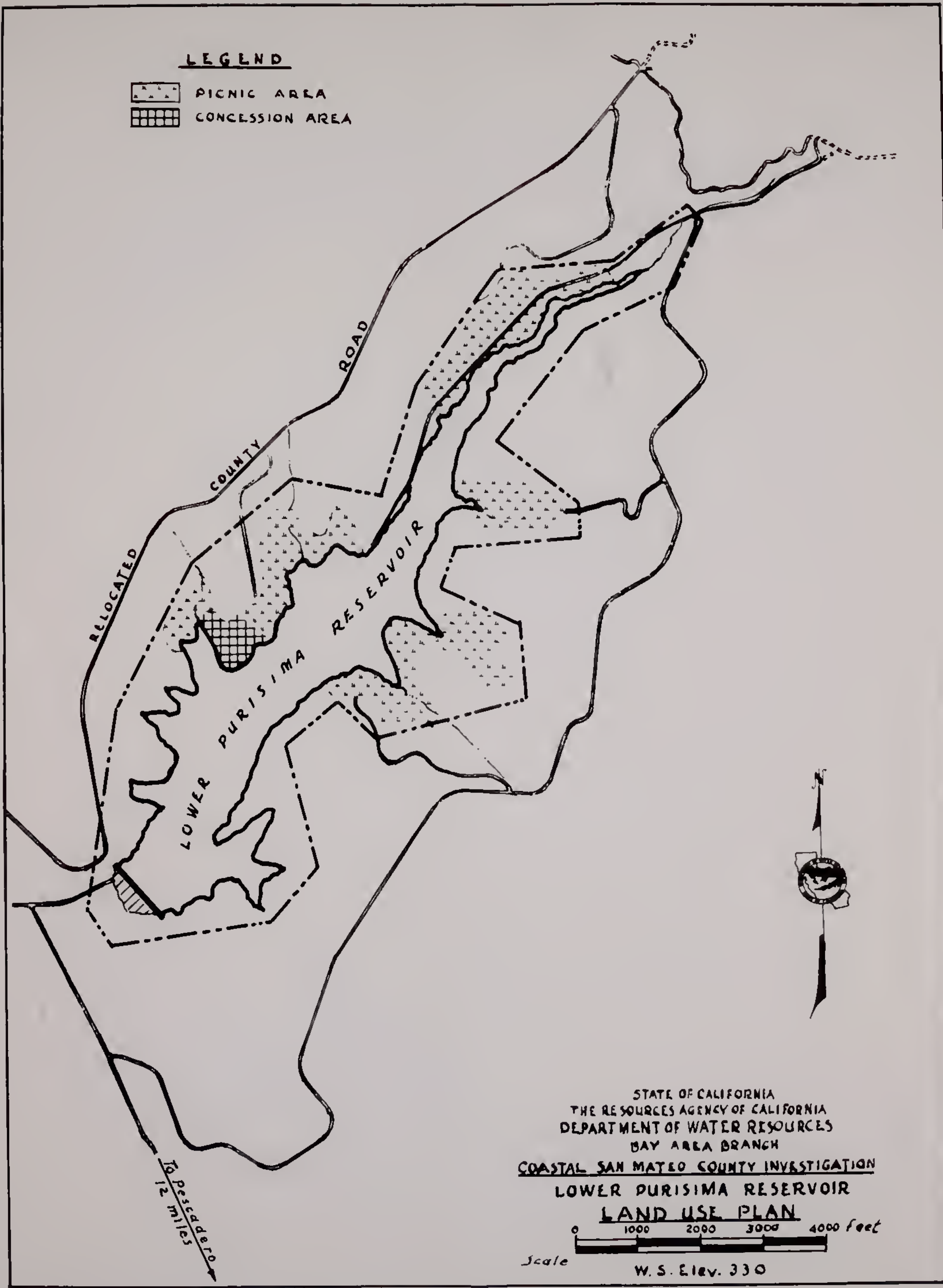
LOWER PURISIMA RESERVOIR

LAND USE PLAN



W. S. Elev. 330

PLATE D3



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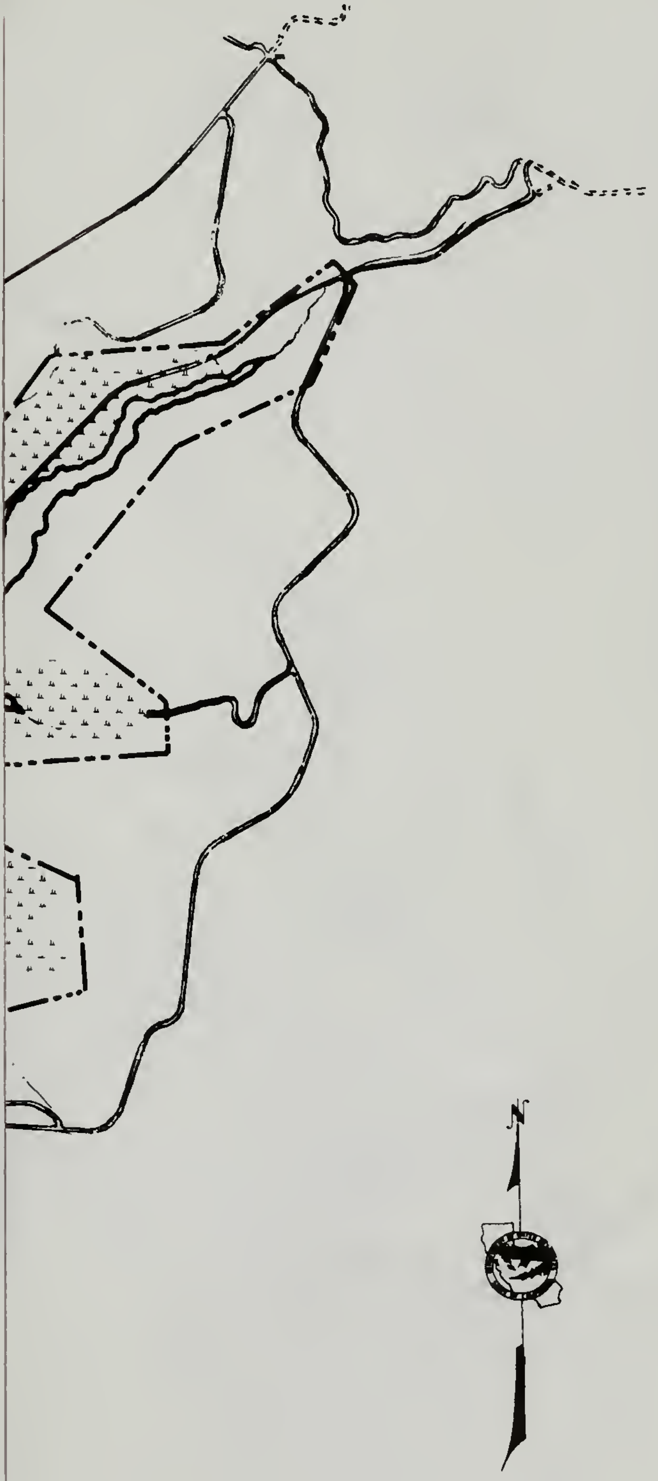
COASTAL SAN MATEO COUNTY INVESTIGATION

LOWER PURISIMA RESERVOIR

LAND USE PLAN

PLATE D3



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LOWER PURISIMA RESERVOIR

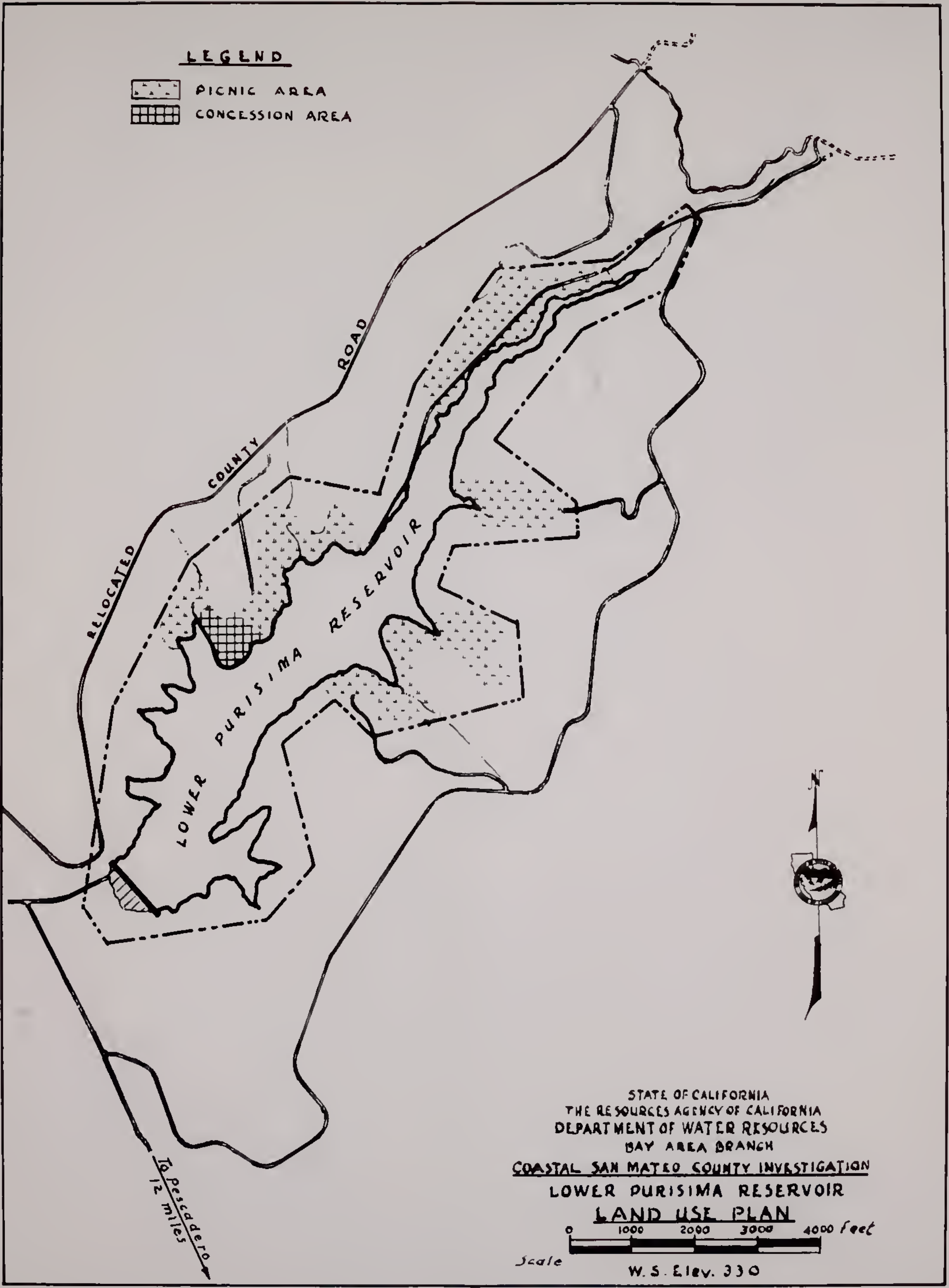
LAND USE PLAN

0 1000 2000 3000 4000 Feet

Scale

W. S. Elev. 330

PLATE D3



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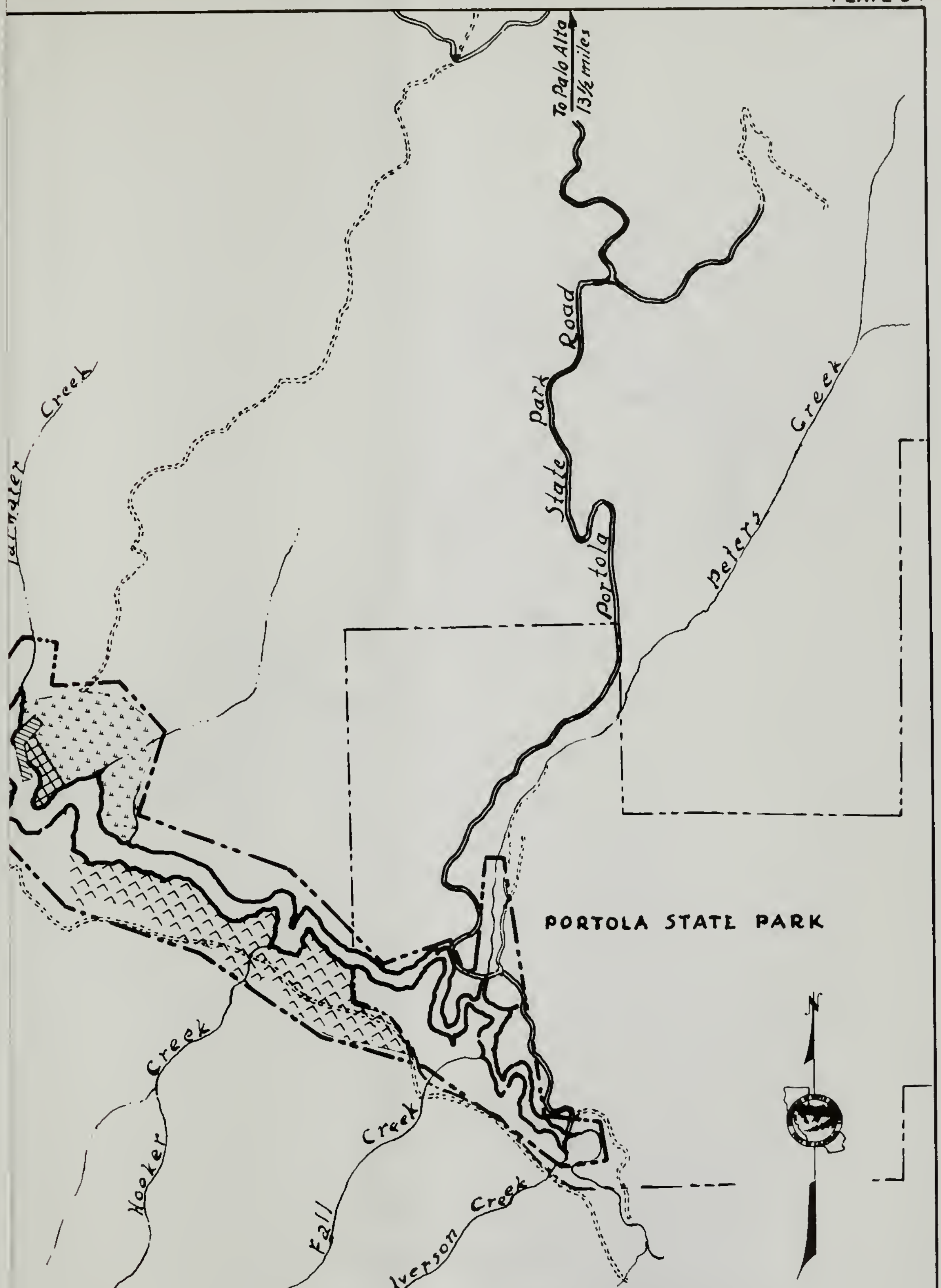
LAND USE PLAN

W. S. Elev. 330

PLATE D4



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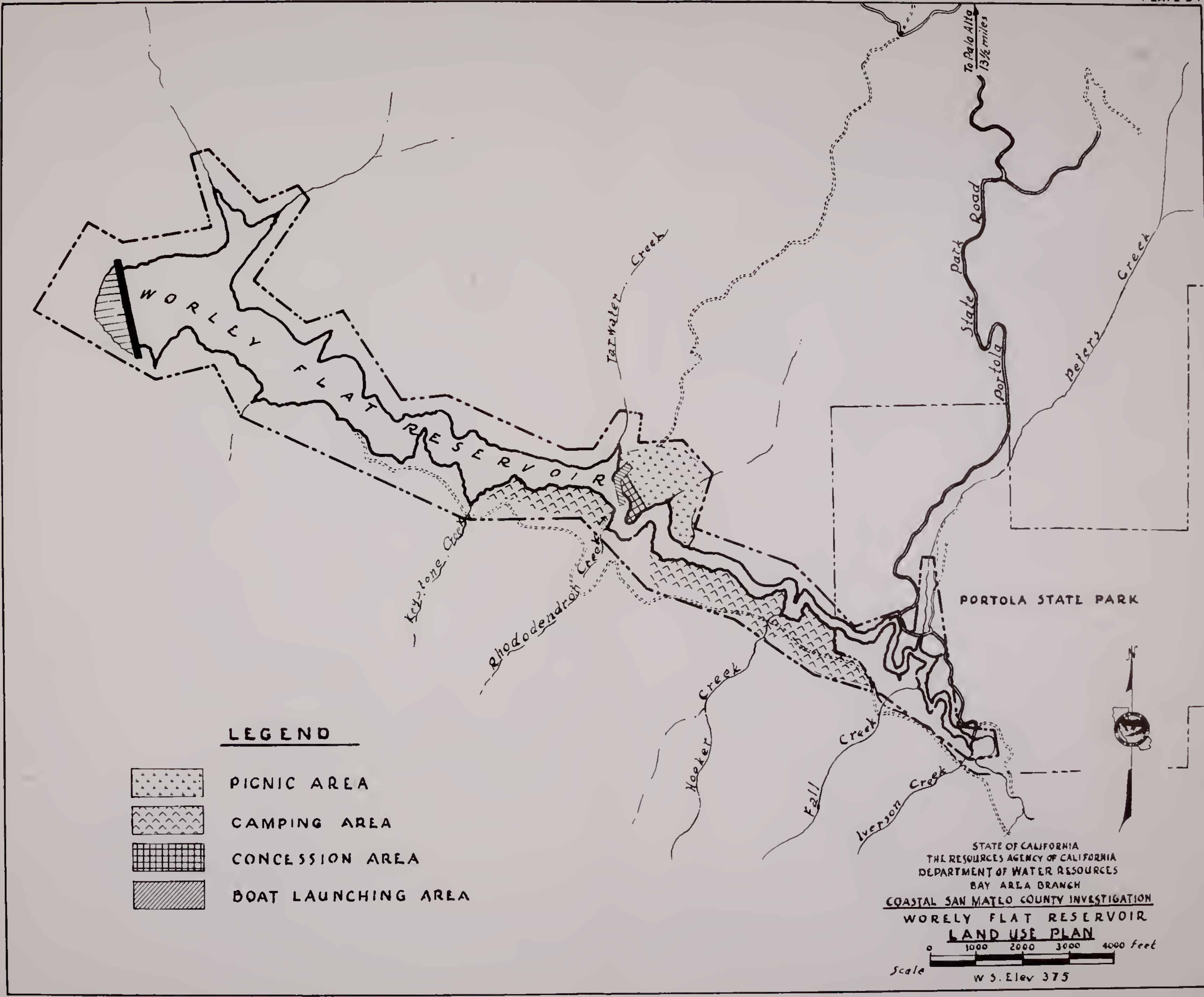
WORELY FLAT RESERVOIR

LAND USE PLAN

0 1000 2000 3000 4000 feet
Scale
W. S. Elev. 375

PLATE D4



LEGEND

- ⛬ PICNIC AREA
- ⌃ CAMPING AREA
- ▦ CONCESSION AREA
- ▨ BOAT LAUNCHING AREA

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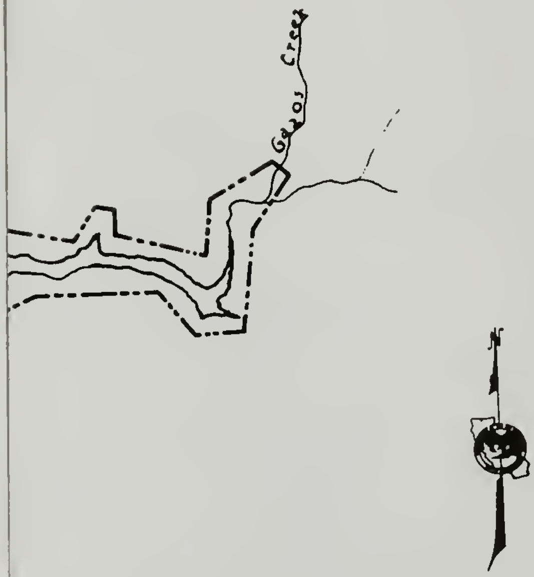
LAND USE PLAN

W.S. Elev 375



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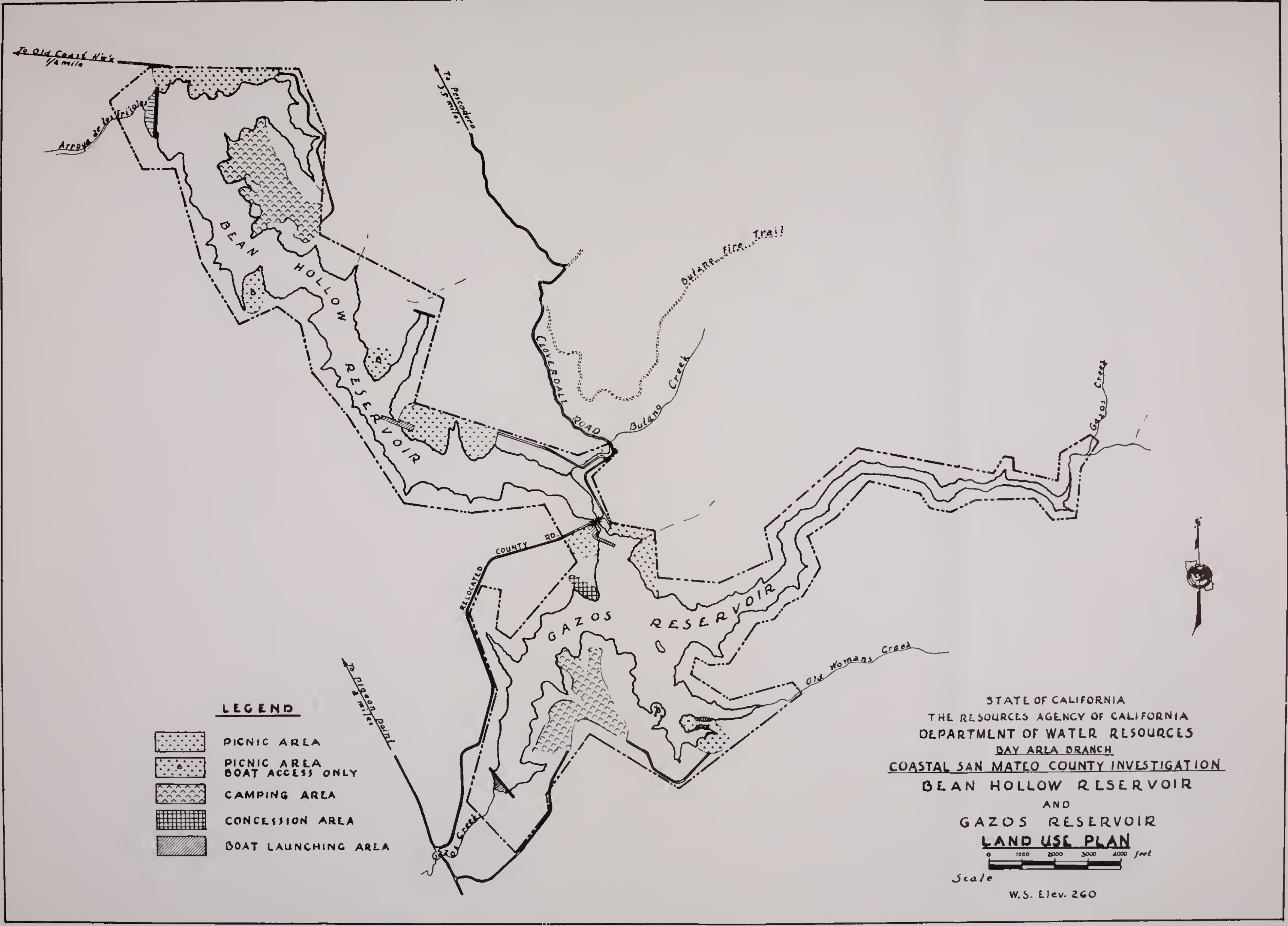
BAY AREA BRANCH
SAN MATEO COUNTY INVESTIGATION

N HOLLOW RESERVOIR
AND
GAZOS RESERVOIR

LAND USE PLAN

0 1000 2000 3000 4000 feet
cale

W.S. Elev. 260



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BEAN HOLLOW RESERVOIR
AND
GAZOS RESERVOIR
LAND USE PLAN

W.S. Elev. 260

LEGEND

░	PICNIC AREA
░ B	PICNIC AREA BOAT ACCESS ONLY
░	CAMPING AREA
▦	CONCESSION AREA
▨	BOAT LAUNCHING AREA

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